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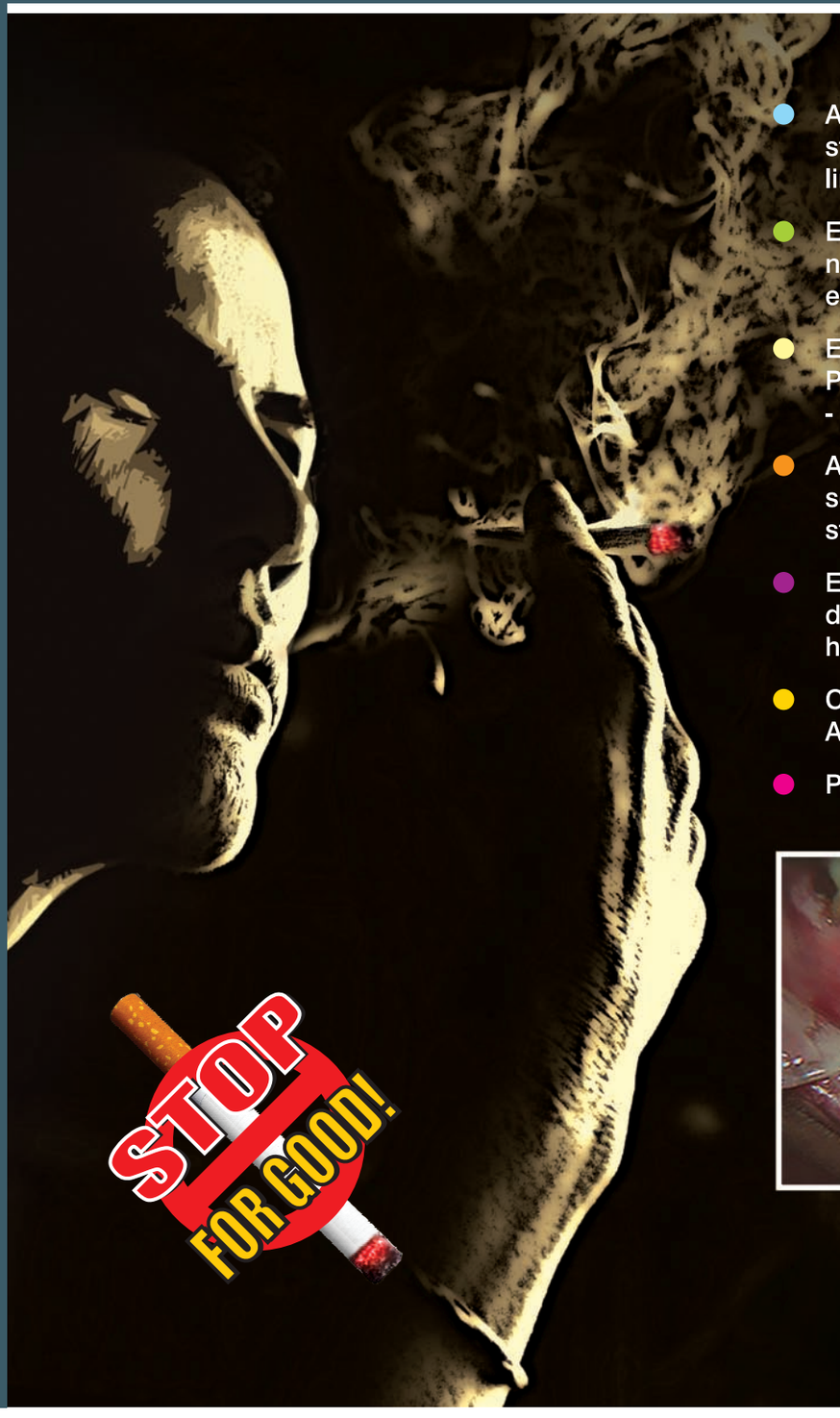

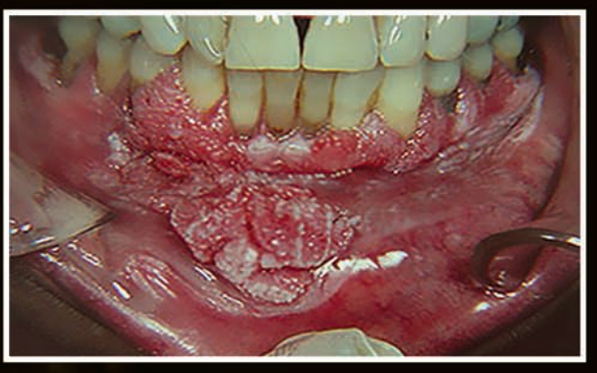

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Smoking

Tobacco has been variously hailed as a gift from the gods, a miraculous cure-all for life's physical ills, a solace to the lonely soldier or sailor, a filthy habit, a corrupting addiction, and the greatest disease-producing product known to man. This diversity of opinion has continued unchanged for centuries and has appeared until very recently to be little affected by research results from more than 900,000 papers thus far published on the topic.

It is common knowledge that cigarette smoking is the single major cause of cancer and cardiovascular disease in the India, contributing to hundreds of thousands of premature deaths each year, yet one-fourth to one-third of Indian adults continue to smoke.

It is especially important to understand that harmful effects of tobacco products are dose-dependent, that they depend more on abuse than on simple use. The nicotine found in substantial amounts in tobacco products is widely considered to be a powerfully addicting drug, so much so that its addictive processes and potential have been equated with heroine, morphine and cocaine. It's rapid absorption through the lungs of cigarette smokers is widely accepted, but its equally ready absorption through the oral mucosa under the alkaline conditions normally found in cigar,. Once in the blood stream, of course, nicotine acts on the central nervous and cardiovascular systems in identical fashion regardless of the method of absorption.

Tobacco smoke is as dangerous to non-smokers as firsthand smoke is to smokers themselves. The EPA has classified tobacco smoke (containing 43 carcinogens) as a Class A carcinogen - a known cause of human cancer. Tobacco can damage cells in the lining of the oral cavity and oropharynx, causing cells to grow more rapidly to repair the damage.

Researchers believe that DNA-damaging chemicals in tobacco are linked to the increased risk of oral cancer, according to the American Cancer Society.

"Each year, smoking kills more people than AIDS, alcohol, drug abuse, car crashes, murders, suicides, and fires - combined!" "Cigarette smokers die younger than nonsmokers. In fact, smoking decreases a person's life expectancy by 10-12 years.

Smokers between the ages of 35 and 70 have death rates three times higher than those who have never smoked."

Prevention is always best, and making healthy lifestyle choices, such as steering clear of tobacco, may help.

Regular dental examinations also are advisable. Anyone who develops a sore or discolored area in the mouth should see their dentist or family doctor if the place does not heal within two weeks.

Edited by: **Dr. K. Nandakumar,** Hon. Editor • Published By: **Dr. Shibu Rajagopal,** Hon Secretary • **For IDA, Kerala State Branch**
Printing: **New Multi Offset Printers**

Kerala Dental Journal

Vol. 34 | No. 1 Supplement | March 2011

Contents

President's Message

Dr. Santhosh Sreedhar

President Speaks

I have great pleasure in writing this message to this special issue of our Journal. Recently we have taken a decision to provide adequate publishing space for our members who would like to get their research work published. The response from the aspiring and budding research workers and the young professionals were overwhelming, confirming the fact that there is enough research talent in our country. But there was an undesirable negligence on the part of the youngsters in getting their work published. The long waiting period with the established journals was another deterrent. Scientific world always give credit to the findings which are published first. In order to help timely publication, IDA Kerala State decided to bring out this supplementary issue.

While taking a very positive attitude I also feel to point out certain hard facts also. The editorial board is of opinion that many authors submit the manuscripts without taking much care. Many have forgotten to include legends to figures and references were not cited in the text. The board feels that the authors should learn more about the basics of scientific writing and also should know about the importance of academic publishing.

In academic publishing, a scientific Journal is a periodical publication intended to further the progress of science usually by reporting new research. Scientific Journal contains articles that have been peer reviewed in an attempt to ensure that articles meet the journal standards of quality and scientific validity. Although scientific journals are superficially similar to professional magazines, they are actually quite different. Issues of a scientific journal are rarely read casually, as one would read a magazine. The publication of the results of research is an essential part of the scientific method. If you are describing experiments or calculations, they must supply enough details that an independent researcher could repeat the experiment or calculation to verify the results. I may have to point that, in an article, contents is 49% and the presentation is 51%. You have to upgrade the standard of the article and that in turn will upgrade the standard of the journal. You have to go through the editorial of this issue and try to upgrade yourself. For excellent articles and original work, publishing space will not be a problem in the future.

Indian Dental Association will stand by you to publish the research work which will ultimately improve the quality of treatment that we deliver to our patients and the society at large.

Dr. Santhosh Sreedhar
President, IDA Kerala State.

Dr. K. Nandakumar

On publishing an article

Publishing has become a compulsion and hence editorial offices of journals are flooded with articles. This is no reflection of the scientific activities that take place in the dental colleges. Majority of the articles fall into two categories: over view of a topic (the so called review) and case reports. On most of the occasions the former is a direct adaptation of text books and the latter, the report of singular case. Most of the articles when submitted do not follow the basic rules described in the 'Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication' (Updated April 2010) published by the International Committee of Medical Journal Editors.

Who is an author: Authorship credit should be based on 1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. Authors should meet conditions 1, 2, and 3. All persons designated as authors should qualify for authorship, and all those who qualify should be listed.

Protection of Human Subjects and Animals in Research: When reporting experiments on human subjects, authors should indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.

Duplicate Submission: Most biomedical journals will not consider manuscripts that are simultaneously being considered by other journals.

Preparing a Manuscript for Submission: Editors and reviewers spend many hours reading the manuscripts, and therefore appreciate receiving manuscripts that are easy to read and edit. The text of observational and experimental articles is usually divided into the following sections: Introduction, Methods, Results, and Discussion. This so-called "IMRAD" structure is not an arbitrary publication format but rather a direct reflection of the process of scientific discovery. Other types of articles, such as case reports, reviews, and editorials, probably need to be formatted differently.

Double-spacing all portions of the manuscript-including the title page, abstract, text, acknowledgments, references, individual tables, and legends-and generous margins make it possible for editors and reviewers to edit the text line by line and add comments and queries directly on the paper copy. If manuscripts are submitted electronically, the files should be double-spaced to facilitate printing for reviewing and editing. Authors should number all of the pages of the manuscript consecutively, beginning with the title page, to facilitate the editorial process.

Article title: Concise titles are easier to read than long, convoluted ones. Titles that are too short may, however, lack important information, such as study design (which is particularly important in identifying randomized, controlled trials). Authors should include all information in the title that will make electronic retrieval of the article both sensitive and specific.

References: References should definitely be cited in the text. Although references to review articles can be an efficient way to guide readers to the body of literature, review articles do not always reflect original work accurately. Readers should therefore be provided with direct references to original research sources whenever possible. Small numbers of references to key original papers often serve as more exhaustive list. References should be numbered consecutively in the order in which they are first mentioned in the text. Identify references in text, tables, and legends by Arabic numerals (Vancouver style).

Tables: Type or print each table with double-spacing on a separate sheet of paper. Number tables consecutively in the order of their first citation in the text and supply a brief title for each. Do not use internal horizontal or vertical lines. Give each column a short or an abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading.

Illustrations (Figures): Figures should be either professionally drawn and photographed, or submitted as photographic-quality digital prints. In addition to requiring a version of the figures suitable for printing, some journals now ask authors for electronic files of figures in a format (for example, TIF, JPEG or GIF) that will produce high-quality images in the Web version of the journal; authors should review the images of such files on a computer screen before submitting them to be sure they meet their own quality standards. Figures must be accompanied by legends and serial numbers printed on a separate page. Figure number should be cited in the text.

Abbreviations and Symbols: Use only standard abbreviations; use of nonstandard abbreviations can be confusing to readers. Avoid abbreviations in the title of the manuscript. The spelled out abbreviation followed by the abbreviation in parenthesis should be used on first mention unless the abbreviation is a standard unit of measurement.

Authors are encouraged to go through the 'Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication' (Updated April 2010) which is readily available in the net before sending in manuscripts.

Dr. K. Nandakumar
Editor, KDJ

Case report

Palatal swelling

* Jacob John, * Tony P Mathew, **Anoopraj SK

Abstract

Palatal swellings are more common but sometimes very much fatal. Palatal abscess, palatal cyst, palatal tori, verrucuous carcinoma and minor salivary gland neoplasms are some of them. Here we came across with adenoid cystic carcinoma, a malignant neoplasm of minor salivary glands of palate with perineural spread and increased radio resistance. We treated this case with partial maxillectomy and radio therapy, with 3 year follow up.

Introduction:

Palatal swellings are always a dilemma for the practitioner because so many pathologies present with palatal swelling. So a systematic approach is needed for the diagnosis of the pathology. Initial aid of diagnosis is clinical examination which includes inspection, palpation, and aspiration from the local site. If the aspiration is positive, with pus or other fluid, the swelling may be infectious or cystic, if not, it can be a more fatal condition. After that we go for further examination, which include routine blood examinations and radiographic examinations, which reveals out the real problem. Confirmation is done with histopathological examination. In this case, we followed this protocol and finally the actual pathology was revealed- *Adenoid cystic carcinoma of minor salivary glands of palate.*

Clinical features:

salivary glands most commonly involved by adenoid cystic carcinoma are parotid, sub maxillary and accessory gland in the palate and tongue. This tumour occurs most commonly during the 5th and 6th decades of life. It is more common in females. Many of the patients exhibit clinical manifestation of early local pain, fixation to deeper structures, local invasion. The intra oral lesion may exhibit surface ulceration. Adenoid cystic carcinoma has a marked tendency to spread through perineural spaces and usually invades well beyond the clinical apparent borders.

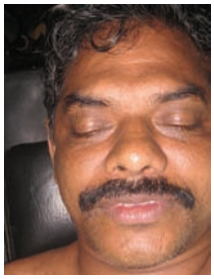
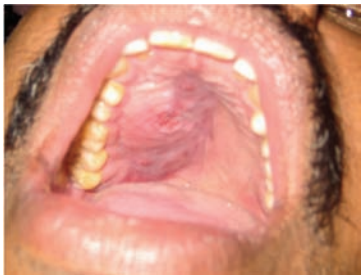
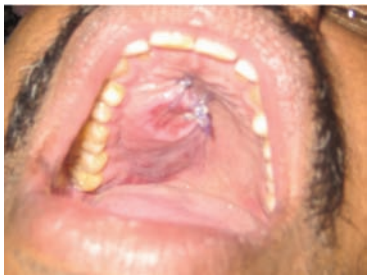
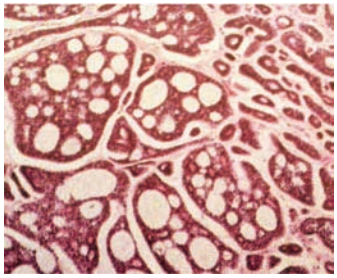
Case report

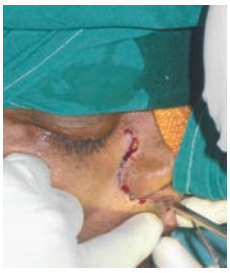
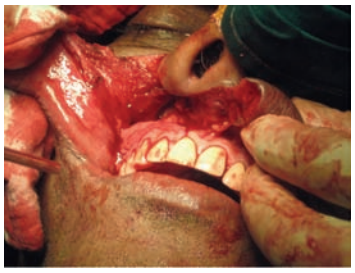
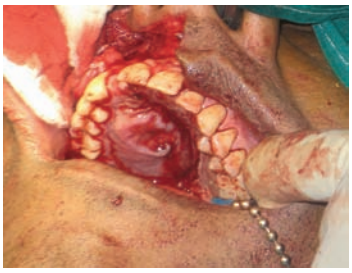
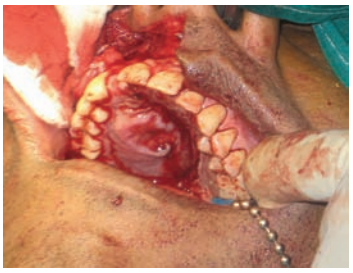
A 55 year old man presented to OPD with palatal swelling which increased in size for since 1 month. Patient was treated in a local hospital with antibiotics, considering the swelling as palatal abscess. We took over the case and did a thorough clinical examination. The swelling was in the posterior part hard palate oval, about 4×4cm in size. It was firm, non tender and non-fluctuant. Aspiration was negative. No regional lymphadenopathy. Biopsy was taken from local site and sent for histopathological examination. CT, OPG, occlusal radiograph were taken, Clinical, and radiological results were suggestive of a major problem. Routine blood examination was done, which showed low Hb count, increased lymphocytes and increased ESR.

Histopathologic report revealed cribriform pattern with basaloid epithelial cell nests resembling *Swiss cheese* pattern commonly seen in cribriform (classic) type adenoid cystic carcinoma.

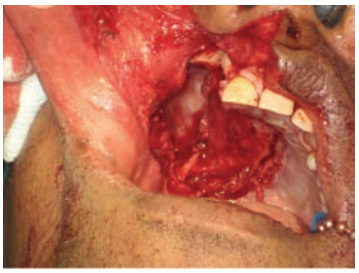
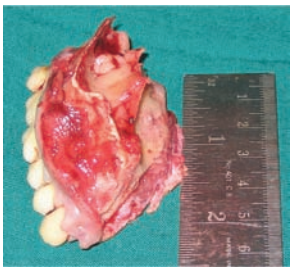
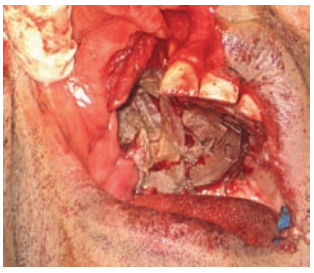
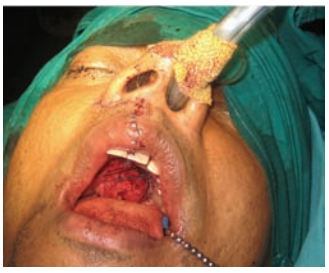
Multiple punch biopsy was taken from anterior, posterior, medial and from the centre of the lesion, which confirmed the diagnosis and helped to identify the clear margins

Weber Fergusson approach- a standard approach for partial or total maxillectomy was used in this case incision begin in the midline of upper lip through philtrum up to collumella of nasal cavity, curving around the nasal vestibule and ala of nostril up to the nasolabial crease up to the medial canthus. Upper lip is divided through its full thickness up to gingivolabial sulcus. To elevate the upper cheek flap an incision is made in the mucosa of upper gingivobuccal sulcus the flap is elevated in full thickness to expose the maxilla. Maxillectmoy was done approximately 1.5 cm around the visible and palpable lesion. Bone cuts made with bur, osteotomes later. Pterygoid disjunction was done to remove the affected maxillary area in total.

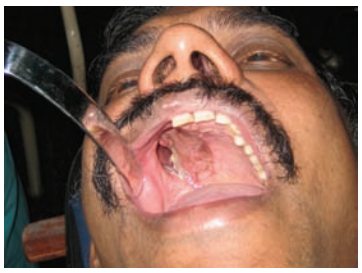
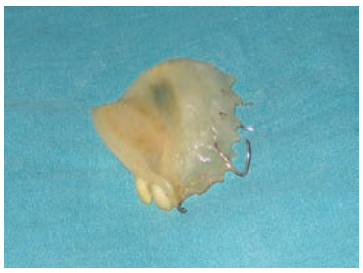
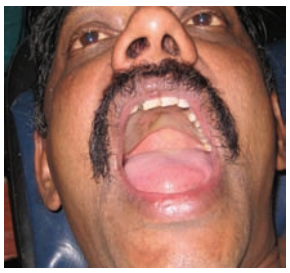





Weber Fergusson incision | Exposure of maxilla | Removal of lesion

Post operative defect | Excised specimen | Immediate skin grafting

Post operative 3 year follow up

Skin grafting was done over the raw area as superficial dressing and for early granulation. Pre fabricated sterile obturator was fixed over the surgically created defect. Full thickness flap was repositioned and closed in layers with 4-0 vicryl and 5-0 proline. Hospital stay was uneventful. Histopathology results conform the lesion as adenoid cystic carcinoma allaaround with clear margins.

Post operative follow up done in first, second and third week. Post operative radiation was given at forth week. Sixth month first year and second year follow up was done. No recurrence of lesion was reported

Discussion

Adenoid cystic carcinoma is an infiltrative malignant tumour relatively common in the salivary glands, usually with perineural and perivascular spread. It shows three growth patterns glandular, tubular, solid. Solid pattern shows worst prognosis. After surgery alone local recurrence is frequent because of infiltrative growth pattern and perineural spread. A planed surgery with timed and adequate post operative radiation therapy proved as good treatment protocol for adenoid cystic carcinoma.

Conclusion

Palatal swellings are very common oral pathology. So there need a great skill to identify the actual pathology. We should follow the correct protocol to diagnose the real problem, because the treatment depends on our final diagnosis. In our case we followed the correct guide line, so we found out the real pathology Adenoidcystic carcinoma and managed it successfully.

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DIFFERENTIAL DIAGNOSIS FOR PALATAL SWELLINGS WITH TREATMENT

LESION	PREVALENCE		CLINICAL FEATURES	HISTO PATHOLOGY	TREATMENT
	AGE	SEX			
Palatal Abscess	Any age	M=F	Soft, fluctuant adjacent tooth is tender on percussion regional lymphadenitis fever.	Composed of disintegrating PMN leucocytes surrounded by viable leucocytes cellular debris Necrotic materials and bacterial colonies	Incision and Drainage Extraction of affected tooth.
Dentigerous Cyst	20-30	M>F	associated with impacted canine Expansion of Anterior maxilla with pathologic fracture	stratified squamous epithelium lining the lumen, rete pegs absent, rushton bodies present	Enucleation or marsupialization
Radicular Cyst	40-50	M>F	anterior maxillary region associated with non vital teeth.	stratified squamous epithelium lining the lumen, rete pegs absent, rushton bodies present collection of cholesterol cleft with associated multinucleated giant cells	Enucleation, marsupialization or excision
Nasopalat-ine Cyst	40-60	M>F	small well defined fluctuant swelling just posterior to Palatine papilla	lined by squamous columnar, cuboidal or combination. Dendritic melano cytes are also seen	Surgical enucleation
Globulo Maxillary Cyst	20-30	M=F	soft cystic swelling seen usually between maxillary lateral incisor and cuspid, seen as pear shaped radiolucency	lined by stratified squamous or ciliated columnar epithelium	Surgical enucleation
Mucocoele	20-30	M=F	5-10mm diameter, Bluish, oval, soft or hard in consistency, on aspiration yields sticky viscous clear fluid,	Vacuolated macro phages-muciphage	surgical excision, cryosurgery
Torus palatinus	20-30	F>M	hard bony out- growth in the mid line of palate, may be flat, spindle, nodular or lobular.		Surgical excision if needed
Verrucous Carcinoma	60-70	M>F	Carcinoma of smoker's palate Exophytic papillary with a pebbly surface, regional nodes often enlarged and fixed	epithelial proliferation with down growth of epithelium into the connective tissue, pleomorphism and hyperchromtism is seen	Surgery, radiation, or combination therapy
Pleomor-phic Adenoma	40-60	F>M	posterior palatal region, firm, encapsulated	combination of glandular epithelium and mesenchyme like tissue (myxoid, chondroid or osteoid)	Surgical excision, radioresistant
Mucoepide-rmod Carcinoma	50-60 Young Children	M=F	posterior palatal region, ill defined swelling, may be ulcerated, regional, lymphadenopathy	mucous secreting cells, epidermoid cells and intermediate cells	Surgical excision
Adenoid cystic Carcinoma	50-60	F>M	posterior palatal region, fixation to deeper structures, firm in consistency, perineural spread, no regional lymphadenopathy	3 patterns: Cribriform (Swiss cheese or honey comb pattern) tubular, solid	Surgical excision
Necrotising Sialometa-plasia	Any age	M>F	ulcerative painless swelling on hard palate with everted margins	chronic inflammation acinar necrosis squamous metaplasia of ducts, lobular architecture is preserved.	Heals spontaneously debridement and irrigation

salivary and lacrimal gland origin: localization, classification, clinical pathological correlation, treatment results and long term follow up control in 84 patients. anti cancer Ress 23(2A):931-940, Mar-Apr 2003

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*** Asst. Professor, ** House Surgeon, Dept of OFMS. Azeezia College of Dental Sciences and Research, Meeyannoor, Kollam**

Case report

Residual cyst

* Sunitha M., ** Anitha John, ** Binu. S.M.

Abstract

Residual cysts are inflammatory odontogenic cysts that persist in the jaw after extraction of the offending tooth. Residual cysts are often asymptomatic and are discovered during routine radiographic examination. However, residual cyst becomes symptomatic when it gets infected, necessitating surgical exploration which imposes additional trauma to the patient. Such a clinical situation could be avoided if a proper diagnostic and treatment regimen is followed. A case of residual cyst that reported to our O.P is discussed in this article

Introduction

Radicular cysts are the most common inflammatory cysts that arise from the epithelial residues in the periodontal ligament as a result of apical periodontitis following death and necrosis of the pulp. Quite often a radicular cyst remains behind in the jaws after removal of the offending tooth and this is referred to as a residual cyst. There have been relatively few publications on the subject although it has been estimated that they represent approximately 10% of all odontogenic cysts.[1,2] Jones etal in their study have reported that radicular cysts comprise 52.3% and residual cysts about 8% of all odontogenic cysts. [3] Various studies have been done on a series of asymptomatic and symptomatic residual cysts to assess the factors that decide whether a radicular cyst will resolve or persist after tooth removal. There have been reported cases of squamous cell carcinoma occasionally arising from the epithelial lining of radicular and residual cysts. Therefore it is vital to realize that careful clinical examination is essential to eradicate such cysts.

Case report

A 55 year old female patient reported to the department with a complaint of swelling in the left lower back tooth region since 2 months. The patient had pain in the left lower back tooth following which she noticed a swelling in the region 2 months back. The painful tooth was extracted 2 weeks back. But the swelling persisted till now. She was a known diabetic and hypertensive and was under medication. Intraoral examination revealed missing tooth 34 and a swelling of size 1*1 cm in relation to the buccal aspect of 34 (Fig 1). The surface was smooth and the overlying mucosa was of the same colour as that of the adjacent mucosa. On palpation, buccal cortical expansion was noted in 34 region. IOPA of the region and Panoramic view showed missing 34 and a well defined radiolucency of size about 1.5*1 cm between 33 and 35 (Fig 2, 3). Sclerotic margin was noted in the inferior aspect of the radiolucency. Based on the history, clinical examination and radiographic findings, a provisional diagnosis of a residual cyst was made. Blood sugar examination was done and was found to be within normal limits. Surgical enucleation of the cyst was done and the specimen submitted for histopathological examination (Fig 4) which revealed a cyst lined by granulation tissue with fibrous tissue and bone in the wall. Part of the cyst wall was lined by stratified squamous epithelium. The granulation tissue lining the wall showed infiltration by plasma cells and lymphocytes (Fig 5) and a final diagnosis of infected dental cyst (residual) was made.

Discussion

Residual cysts are those that remain after the associated tooth has been removed or arise from the residual epithelial rests of Malassez from the periodontal ligament of the lost tooth. They are usually found in patients older than 20 years, the average age being 52 years. It is twice as common in men than women and maxilla is more commonly involved than mandible.[4] It seldom reaches more than 0.5 cm in diameter but may be large enough to cause facial asymmetry. They are generally asymptomatic but become symptomatic if infected. High and Hirschmann (1986) in their studies on symptomatic and asymptomatic residual cysts showed that asymptomatic cysts showed a decrease in size with increasing age.[5] They also noted that there was an unexpectedly large number in the mandibular premolar region which was true in our case also. There was a direct relationship between the age of the cyst and the radiological and histological evidence of mineralization. There was an overall reduction in

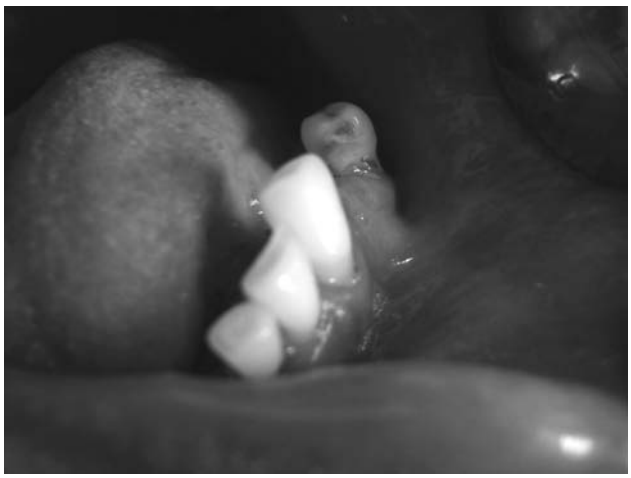

Fig 1. Swelling on buccal aspect of missing 34

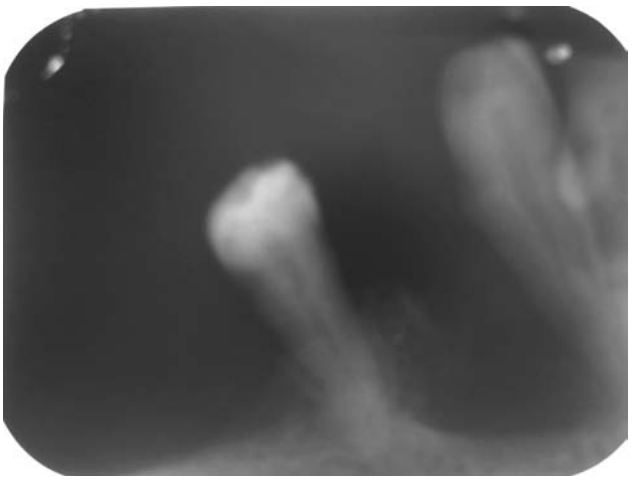

Fig 2. IOPA showing well defined radiolucency in 34 region

epithelial thickness with cyst age and all cysts showed minimal chronic inflammatory changes. They concluded that vast majority of residual cysts are slowly resolving lesions. Nevertheless they do persist and there was no evidence of complete resolution. Radiographically residual cysts occur as a well defined round to ovoid radiolucency with corticated borders at the site of a previously extracted tooth. In infected or rapidly enlarging cysts, the radiopaque margin may not be present. Residual cysts must be differentiated from odontogenic keratocyst, primordial cyst and traumatic bone cyst. This can be done by a proper history taking and clinical examination. Keratocysts more often expand anteroposteriorly rather than causing a buccal cortical expansion and the history of extraction of a carious tooth supports the diagnosis of residual cyst. In our case there was a well defined area of radiolucency with presence of corticated borders at the inferior aspect in the mandibular premolar region which is suggestive of an infected cyst. The histopathological features of the residual cyst are similar to that for conventional radicular cysts. The epithelial lining may be thin and regular and indistinguishable from a developmental cyst such as a dentigerous cyst or lateral periodontal cyst. High and Hirschmann (1998) showed that there was an inverse relationship between the percentage of PMN in the inflammatory infiltrate and cortication of the cyst wall radiographically [6] In our case there was an increased concentration of inflammatory cells histopathologically and lack of well defined cortication radiographically which supports these findings. Single cases of squamous cell carcinoma arising in a residual radicular cyst have been reported by Kay and Kramer (1962), [7] Van der wal etal (1993)[8] and Swinson etal (2005)[9]. Kim etal (1997) reported a case of squamous cell carcinoma arising from residual odontogenic cyst and that more than 60% of cases of carcinoma developing from residual cysts were well differentiated with good prognosis.[10]

Nair (1998, 2003) considered that the type of cyst was important with regard to persistence after treatment.[11] He confirmed the work of Simon (1980)[12] who showed that there were two types of radicular cyst. One is the true radicular cyst which contains a closed cavity entirely lined by epithelium and the periapical pocket cyst (originally called the bay cyst by Simon) in which the epithelium is attached to the margins of the apical foramen in such a way that the cyst lumen is open to the affected root canal. Thus it is expected that the pocket cyst would heal after endodontic treatment or tooth extraction, while the true cyst being completely enclosed may persist in the absence of the cause. Nair etal (1996) showed that only 15% of periapical lesions were radicular cysts and of these 61% were true cysts and 39% were pocket cysts[13]. Our case was that of a true cyst which persisted after extraction of the offending tooth. Treatment of a residual cyst is similar to that of any intra bony odontogenic cyst. When the patient's age and systemic condition is compromised and if the size of the cyst is large, marsupialization or decompression may be attempted. Small cystic cavities < 2 cm do not need any specific treatment after cyst enucleation. After surgery the coagulum becomes organized and new bone forms in the cavity. For cysts >4cm autologous bone transplantation with Bone morphogenetic protein (BMP) can be done to stimulate bone formation. Biomaterials like Tissucol (fibrin glue) mixed with titanium granules may be used to fill large bone cavities.[14]

Conclusion

To conclude, it is imperative to avoid misdiagnosing a cyst for an abscess and misinterpreting that the lesion will subside on extraction of the tooth in all cases. Regardless of the type of the cyst, it is suggested that in

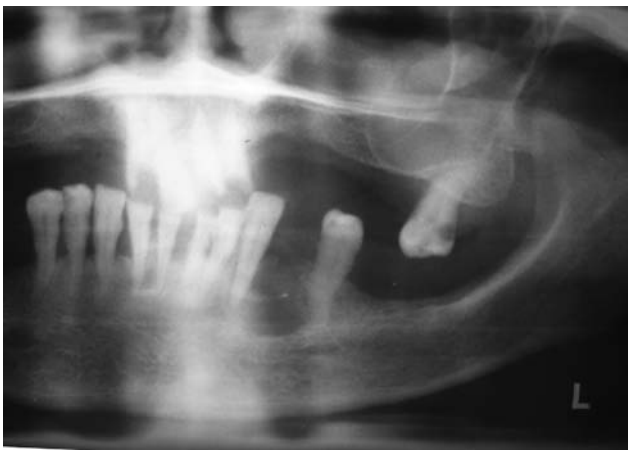

Fig 3. Panoramic view shows presence of a well defined area of radiolucency with lack of a well corticated margin

Fig 4. Enucleated specimen

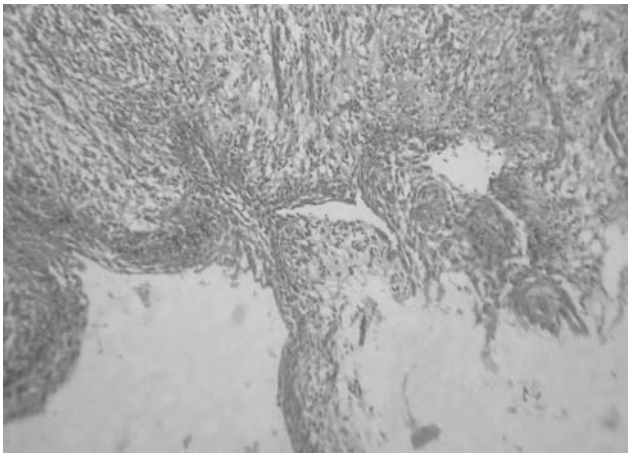

Fig 5. H & E Section showing cyst wall lined by epithelium and inflammatory cell infiltration

case of a periapical cyst, cyst enucleation be done following tooth extraction or root canal treatment with apicoectomy of the involved tooth to avoid unnecessary surgical exploration and trauma to the patient in future. Residual cyst can become a non entity when a careful diagnosis and accurate treatment modality is followed.

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A comparative evaluation of bond strength and hardness of soft denture liners after thermocycling

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Introduction

The residual alveolar ridges are borne to bear the forces acting on denture. If supporting ridge is thin and sharp it may cause chronic pain and discomfort to patient. Soft liners attached to the tissue surface of the denture absorb and distribute the forces, providing cushioning effect to the underlying tissue thereby improving patient comfort. They are also useful in treating patients with extensive bony prominence, congenital or acquired oral defects requiring obturation, superficial mental nerve, xerostomia, bruxing tendencies[1,2] The use of soft liners under a transitional prosthesis during the healing period for osseointegration of implants, or lining an implant supported overdenture are the recent application that have emerged in the past few years. In these cases softliners should possess good longevity and cushioning effect. The longevity of softliner may be affected by tensile and shear forces acting on them during function. These forces may lead to debonding of softliner from denture base. An adequate bond between soft liners and denture base is essential. Failure of soft liners is often attributed to a breakdown of this bond; thus the measurement of bond strength is very important[3]. The cushioning effect of softliner depends on its resiliency. The softliner may become hard overtime leading to failure of its primary purpose.

Although there are several reports in the literature comparing and evaluating the properties of softliners[4,5], there are only few reports regarding the evaluation of properties of softliners after thermocycling[6]. The data obtained from comparing the properties of the materials after thermocycling should provide clinicians with useful information for selecting soft denture liners for patients.

The aim of this study is to compare and evaluate the tensile bond strength, shear bond strength, and hardness of two acrylic based and two silicone based softlining materials currently used as denture base linings.

Materials and methods

The materials selected for the study were two acrylic based and two silicone based softliners. The softliners tested in this study were listed in Table I. The properties of softliners studied were tensile bond strength (TBS), shear bond strength (SBS) and hardness. Fortyeight specimens were prepared from four softliners for testing tensile bond strength, and shear bond strength. Twenty disc shaped specimens were prepared from four softliners for testing hardness.

The polymethylmethacrylate (PMMA) blocks were prepared by investing stainless steel (SS) model of dimension 26mm x 26mm x 3.5mm in dental stone. The heat cure acrylic resin (DPI Heat cure, India) was packed into the space occupied by the model and processed according to manufacturer's instructions. After polymerization the PMMA blocks were removed, wet grinded using P500 paper. The final dimension of PMMA blocks measured by vernier caliper (Mitutoyo Digimatic Caliper) was 25mm x 25mm x 3mm. For testing tensile bond strength the PMMA blocks were put top to top in silicone rubber separated by 25mm x 3mm x 3mm stainless steel spacer. The PMMA blocks and spacer were invested in silicone rubber to allow easy removal of specimen from the disc. The silicone rubber along with PMMA blocks and spacer were invested in dentalstone in a dental flask (Fig 1). The softliners were packed into the space occupied by the spacer and the liners were processed according to manufacturer's instructions. The specimens for shear bond strength test were prepared by placing PMMA blocks side to side in silicone rubber separated 6mm x 3mm x 3mm SS spacer (Fig 2). For testing hardness the specimen preparation and testing were carried out in accordance with ISO specification No: 10139 for soft liners. Disc shaped specimens of dimension 31mm x 6mm (Fig 3) were prepared by investing SS disc in dentalstone in dentalflask. The softliners were packed into the mould and processed according to manufactures instructions. The specimens for testing tensile bond strength, shear bond strength, and hardness were removed from the mould smoothened with 240 grit silica paper and stored in waterbath for 24hours at 37^0c before subjecting to thermocycling. The specimens were then subjected to thermocycling regimen of 3,000 cycles in a thermocycler system. (Haake-W15,Thermo Electron Corp, United States.) alternated between 5^0C and 55^0C water bath. Dwell time was 1 minute.

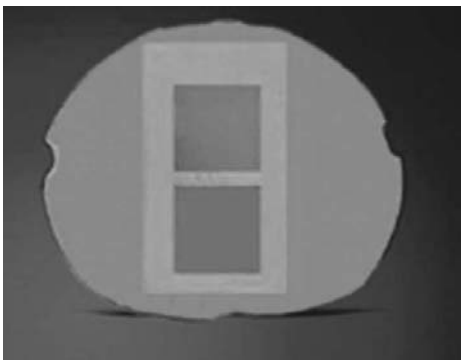

Fig 1. PMMA block and spacer invested in silicone rubber for fabrication of tensile bond strength specimen.

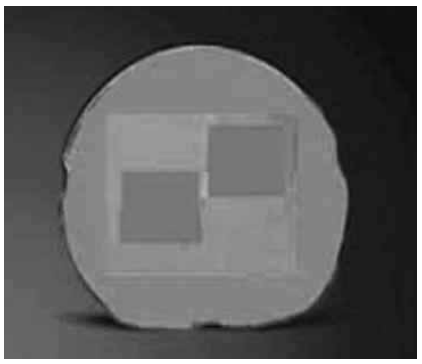

Fig 2. PMMA block and spacer invested in silicone rubber for fabrication of shear bond strength specimen.

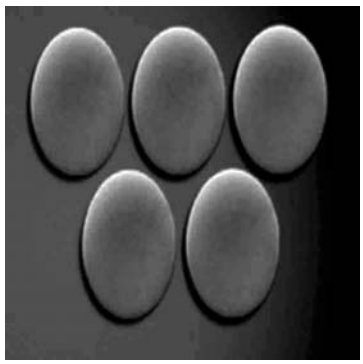

Fig 3. Specimens for testing hardness.

Fig 4. Tensile bond strength testing in Universal testing machine.

Fig 5. Shear bond strength testing in Universal testing machine.

Thermocycled specimen were tested in a Universal Testing machine (instron model no: 3365) at a cross speed of 10mm/minute for determining the tensile bond strength (Fig 4) and shear bond strength (Fig 5). The maximum load "F" before failure was recorded.

The tensile bond strength and shear bond strength was calculated (in MPa) according to the equation: B= F/A, Where, F - Maximum load in Newton (N) before failure, A - Adhesive area in square millimeter (mm^2)

The specimens were tested for hardness with shore–A Durometer test. Five measurements were recorded for each of the specimens. The average of the five readings was recorded for each specimen.

Results

The mean, standard deviation (SD), and one way ANOVA results for tensile bond strength and shear bond strength were shown in Table II and Table III. Nonparametric kruskilwallis ANOVA was employed to compare hardness of four soft denture liners (Table IV). Duncan' s Multiple Range Test was also carried out as post hoc comparison to elucidate the individual group difference. For all statistical evaluations, a two tailed probability of value less than 0.05 was considered significant. The superscript a, b, c, d indicated the difference between the values statically and the values with the same superscript indicates no significant difference.

Statistical analysis by oneway ANOVA (Table II) showed that there was statically significant difference between the tensile bond strength of four soft liners. The highest value of 2.02 Mpa for TBS was obtained for GC reline soft. The lowest value of 0.53 Mpa was obtained for viscogel. The difference between the Shear bond strength of four soft liners was found to be stastically significant (Table III). GC reline soft had greater Shear bond strength than other soft liners. Viscogel had least Shear bond strength than other soft liners. Table IV shows Kruskalwallis ANOVA test for hardness compared between four soft liners. Statistical analysis showed that the difference between hardness of materials was significant. Viscogel had least hardness value compared to other soft liners.

Table I *List of materials and Manufactures*

Product	*Type*	*Manufacturer*	*Batch No*
GC Reline soft	Auto polymerized Silicone rubber	GC Dental products corp.2-285 Toriimatsu-CHO, Japan.	0803111
UfiGel P	Auto polymerized Silicone rubber	VOCO Cuxhaven, Germany.	0845445
GC Soft-liner	Autopolymerised Acrylic based	GC Dental products corp.2-285 Toriimatsu-CHO, Japan.	p-0804033 L-0814832
Visco-gel	Autopolymerised Acrylic based	Dentsply Detrey Gmgh 78467 Konstanz, Germany.	p-0812000454 L-0835700113

Table II. *Analysis of variance (One Way ANOVA) comparing mean tensile bond strength (MPa) between four different groups*

Group	*Mean*	*± SD*	*F value*	*p value*
GC-Reline Soft	2.02[d]	0.59		
Ufigel – P	1.57[b]	0.35		
GC- Soft Liner	1.19[c]	0.19	70.11	< 0.001
Viscogel	0.53[a]	0.20		
a, b, c, d – Means with same superscript do not differ each other (Duncan's Multiple Range Test)				

Table III *Analysis of variance (One Way ANOVA) comparing mean shear bond strength (MPa) between four different groups*

Group	*Mean*	*± SD*	*F value*	*p value*
GC-Reline Soft	2.50d	0.72		
Ufigel – P	1.57c	0.60		
GC- Soft Liner	1.22b	0.51	58.049	< 0.001
Viscogel	0.42a	0.30		
a, b, c, d – Means with same superscript do not differ each other (Duncan's Multiple Range Test)				

Table IV. *Analysis of variance (Kruskal Wallis ANOVA) comparing mean shore A hardness between four different groups*

Group	*Mean*	*Median*	*+ SD*	*H value*	*p value*
GC-Reline Soft	48.16d	47.00	3.29		
Ufigel – P	28.40c	28.00	0.82		
GC- Soft Liner	24.36b	25.00	1.19	93.703	< 0.001
Viscogel	5.68a	5.00	1.14		
a, b, c, d – Means with same superscript do not differ each other (Duncan's Multiple Range Test)					

Discussion

The durability of a softliner depends on its adhesion to denture base and its ability to retain its resiliency. The bond strength of soft liners to denture base may get affected by aging in water, stresses acting on denture, use of a primer with the lining material, the nature of denture base material and the temperature.[7] When soft liner is immersed in water, it swells due to absorption of water resulting in stress build up at the bond inter face[8]. There is also a change in viscoelastic behavior due to leaching of plasticizer. The material becomes stiffer and transmits the external load to the bond site.[9] so to study the true nature of the material; the properties should be analyzed after thermocycling. A study conducted by Yasmin has shown that there is a significant reduction in tensile bond strength after thermocycling.[10] The evaluation of bond strength and hardness after thermocycling will simulate the clinical situation. Silicone based softliners (GCreline soft and Ufigel) showed superior tensile bond strength and shear bond strength than acrylic based soft liners. The adhesive supplied with silicone softliners may have a role to play for its superior bond strength. Viscogel had least bond strength compared to other soft liners. The low bond strength of Viscogel compared to other soft liners is due to the significant effect of aging process which causes swelling and stress building at the bond interface.

The material selected for long term clinical use should have good tensile bond strength and shear bond strength. GC-reline soft shows superior tensile bond strength and shear bond strength than other three soft liners, so it is the material of choice in clinical situation which requires long term service of soft liners.

According to ISO specification, the hardness of soft liners tested with shore A Durometer should be equal to or less than 55 is soft and equal to or less than 35 is extra soft. In the present study only GC reline soft will fall under the group soft. The other three soft liners will fall under the group extrasoft. For tissue conditioning the extrasoft softliners are preferable. Viscogel showed least value for hardness making it the material of choice for tissue conditioning.

Conclusion

With in the limitation of the study the following conclusions can be made.

1. GC-reline soft showed higher values for Tensile bond strength and Shear bond strength, where as Viscogel showed least value for hardness showing that it is the softest of the soft liners tested.

2. The hardness of GC-reline conformed to the values specified in the ISO specification for 'soft' where as the hardness of other 3 soft liners conformed to the values specified in the ISO specification for "extra soft".

3. The silicone based soft liners (GC-reline, Ufigel-P) showed higher values for the properties tested compared to Acrylic based soft liners.

4. This study shows that for long term use of soft liners, GC-reline is the material of choice, where as for short term use such as for conditioning of tissues the "extra soft" viscogel is the material of choice.

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Cytotoxicity of acrylic denture base resins

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Introduction

Acrylic resins are widely used in the fabrication of dentures and have been shown to be cytotoxic as a result of substances that leach from the resin. The primary cause is the residual monomer. Residual monomer, resulting from incomplete conversion of monomers in to polymer, has the potential to cause irritation, inflammation and an allergic response of oral mucosa. The effects of toxic substances leached from the resins on tissues have been reported by clinical observations,[2-5] in animal models[6,7] and by invitro cell growth.[8] Resins used for the manufacture of denture bases have displayed various degrees of invitro cytotoxicity and in vivo allergic responses, probably caused by unreached components remaining after the polymerization process. Residual monomer concentration varies with the methods and the conditions of polymerization.[1] This article reviews the literature published about cytotoxicity of acrylic denture base materials comparing different types of resins and the different polymerization methods and cycles.

Effect of Polymer to Monomer Ratio

The polymer to monomer ratio is one of the variables that influence the cytotoxicity of acrylic resins. According to Kedjarune etal, the more the monomer added to the mixture, the greater the amount of residual monomer and, therefore more potential for cytotoxicity. Lamb etal studied about the effect of the polymer to monomer ratio on residual monomer levels and observed that resins prepared with a high proportion of polymer (5:3) resulted in significantly lower levels of residual monomer, as compared to these prepared with a lower ratio. (4:3).

Effect of Storage Time and Water Immersion

Storage time is another feature that plays an important role in the cytotoxicity of acrylic denture base materials. Some authors reported that the cytotoxic effect of acrylic resins was greater in the first 24 hours after polymerization and decreased with time. They found that longer a prosthesis is soaked the less cytotoxic effect it is likely to have regardless of the type of the denture base resin. The cytotoxic effect may occur for several days after polymerization, but it can be minimized if the prostheses are stored in water for 24 hours. Therefore, it is recommended that dentists soak the acrylic resin prostheses in water for at least 24 hours before placing them in the patients mouth. It has been advocated that the prosthesis should be immersed in water at 50^0C for 60 minutes, to reduce the amount of released monomer and therefore, the toxic potential of denture base resins, especially the auto polymerized resins.

Effect of Polymerization Cycle

Depending on the polymerization temperature and time, various quantities of residual monomer are left in the polymer resulting in different degrees of cytotoxicity. Kedjarune etal noticed a reduced amount of residual monomer when the polymerization time was extended, thus resulting in less cytotoxic effects.

Harrison and Huggut conducted a study about various heat polymerization denture base polymers those are subjected to various polymerization cycles. The results of the study showed that a 7 hour incubation in water at 70^0C followed by 1 hour at 100^0C was ideal, since it provided maximum conversion of residual monomer.

In contrast, a 7 hour cycle at 60^0C and the cycle of immersing the flask in boiling water, followed by a 5 minute immersion in water at 90^0C, produced a high concentration of released residual monomers. To assess the effect of temperature and polymerization time on the amount of the released monomer, Vallittu etal performed a study and found that auto polymerized resins exhibited higher contents of residual methyl methacrylate than the heat- polymerized resins, which may be due to the rise of temperature in the heat-polymerized resins, which resulted in mobility of the molecular chains, there by facilitating the conversion of monomer in to polymer, Thus, heating cycles with temperatures less than 100^0C may result in polymers with higher methyl methacrylate contents than heating cycles with temperatures in excess of 100^0C. It is also demonstrated that for auto polymerized resins, in which only the polymerization temperature was varied, the amount of residual monomer decreased as the temperature increased.

Effect of Polymerization Method

According to Hensten- Petterson and Wictorin [9], the cytotoxic effect is greater in auto polymerized resins than in heat-polymerized resins. The cytotoxic effects of heat-activated, chemically-activated, and microwave-activated acrylic resins on gingival fibroblasts was reported by Sheridan etal, [18] who found that among the tested materials, the greatest cytotoxic effect was produced by chemically activated acrylic resins. Studies have shown that auto-polymerized resins eluted more substances than did the heat-and microwave-polymerized resins. But studies have revealed that auto-polymerized acrylic specimens when submitted to microwave irradiation after 20 minutes of auto-polymerization showed reduced amount of residual monomer. So it may be assumed that the reduction in the residual monomer content by microwave irradiation could play a major role in decreasing the cytotoxic effects of auto-polymerized acrylic resins due to heating that occurs. A shorter polymerization time and less residual monomer are considered as two of the advantages of microwave polymerization. Visible light-polymerized denture base resins were introduced in the early 1980. Although these resins have been reported to be nontoxic after polymerization, several studies have shown these materials have varying levels of cytotoxicity. The extent of their toxicity depends on the specific formulation of the material[11] and polymerization time. Increasing the polymerization time may reduce resin toxicity. Soaking prostheses fabricated with light-polymerized resins for 24 hours before insertion will reduce the amount of cytotoxic substances such as methyl methacrylate and bis- GMA.[11]

The reviewed articles shows that auto-polymerized resins are more cytotoxic than the heat-polymerized denture base resins, which in turn are more cytotoxic than the microwave polymerized resins. One explanation for such performances could be that microwave irradiation produces higher frequency motion of monomer molecules, increasing initial heat and consequently, resulting in greater conversion of monomers in to polymer. So less residual monomer amount is the advantage of microwave polymerization. Another important consideration is the impact the type of polymerization has on the physical properties of the denture base resins. The residual monomer concentration in the most important parameter in determining variations in mechanical properties of a denture base material. Considering that the amount of residual monomer is dependent on the type of the polymerization, it is likely that a cycle of 7 hours at 70^0C and 1 hour at 100^0C which promoted lower amounts of residual monomer, would result in denture bases with less cytotoxic effects.

Summary

On the basis of the review of the various articles, it may be concluded that the cytotoxic effect of denture base acrylic resins may be related to storage time, powder to liquid ratio, polymerization method, and cycle. Auto-polymerized resins are the most cytotoxic denture base material. Acrylic resins polymerized by microwave irradiation are less cytotoxic, probably because of greater conversion of monomers in to polymer. In addition, water storage may reduce the level of residual monomer, resulting in decreased cytotoxicity of there acrylic denture base materials.

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Regenerative endodontics

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Abstract

Stem cell biology and tissue engineering have made major progress in recent decades. The progress in these fields has promoted the emergence of reg-enerative therapy. These proce – dures stimulates body's intrinsic capacities for regeneration by providing elements and replacements for in vivo repair. Recently there has been an increased interest to apply the concepts of regenerative therapy and tissue engineering to endodontics. This article reviews the various elements in tissue engineering and its applications in endodontics.

Regenerative endodontic procedures are biologically based procedures designed to replace damaged structures including dentin, root structures, as well as cells of pulp dentin complex. There are two approaches to practice regenerative endodontics. One is treatment approach in which well selected cases are managed in a more conservative manner such as revascularization procedures. The other is to advance the concepts of tissue engineering for dentin, pulp, cementum and periodontal ligament regeneration, which is currently, confined to laboratory or animal studies.[1]

Key elements for tissue engineering

Includes stem cells, growth factors, scaffold.

Stem cells are cells found in all multi cellular organisms.[4] They are characterized by the ability to renew themselves through mitotic cell division and differentiation into a diverse range of specialized cell types.[2] All tissues originate from stem cells. Stem cells are commonly defined as either embryonic/ fetal or adult/postnatal. It is important to distinguish between embryonic and postnatal stem cells because these cells have a different potential for developing into various specialized cells (i.e. plasticity). The plasticity of the stem cell defines its ability to produce cells of different tissues. Stem cells are also commonly subdivided into totipotent, pluripotent, and multipotent categories according to their plasticity.[3]

Types

Early embryonic stem cells

Stem cells seen in the early stages of life. These early stem cells are totipotent, i.e. possess the ability to become any kind of cell in the body.

Blastocyst embryonic stem cells

About Five days after fertilization, blastocyst is formed. Embryos at the blastocyst stage contain two types of cells: an outer layer of trophoblasts that eventually form the placenta, and an inner cluster of cells known as the inner cell mass that becomes the embryo and then develops into a mature organism. The embryonic stem cells in the blastocyst are pleuripotent, i.e. having the ability to become almost any kind of cell in the body. The sourcing of embryonic stem cells is controversial and associated with ethical and legal issues, thus reducing their appeal for the development of new therapies.

Foetal stem cells

After 8 weeks of development, the embryo is referred to as a foetus. By this time it has developed a human-like form. Stem cells in the foetus are responsible for the initial development of all tissues before birth. Like embryonic stem cells, foetal stem cells are pluripotent.

Umbilical cord stem cells

Blood from the umbilical cord contains stem cells that are genetically identical to the newborn baby. Umbilical cord stem cells are multipotent, i.e. they can differentiate into a limited range of cell types. Umbilical cord stem cells can be stored cryogenically after birth for use in future medical therapy.

Adult stem cells

This name is rather misleading, because infants and children also have stem cells. Thus the term Postnatal Stem Cells are preferable. These stem cells are found in tissues that have already developed, directing their growth and maintenance throughout life. These cells are

also multipotent. Adult stem cells typically generate the cell types of the tissue in which they reside.

Postnatal stem cells have been found in almost all body tissues, including dental tissues. To date, five types of human dental stem cells have been isolated and characterized[4]: i) Dental pulp stem cells (DPSCs)[6], ii) Stem cells from human exfoliated deciduous teeth (SHED),[7] iii) Stem cells from apical papillae (SCAP),[8,9] and iv) Periodontal ligament stem cells (PDLSCs)[10], iv) Dental follicle progenitor cells (DFPSCs)

The identification of these dental stem cells provides better understanding of the biology of the pulp and periodontal ligament tissues, and their regenerative potential after tissue damage.

Dental pulp stem cells (DPSCs)

DPSCs were isolated for the first time in 2000 by Gronthos et al[6] based on their striking ability to regenerate a dentin-pulp-like complex composed of a mineralized matrix of tubules lined with odontoblasts, and fibrous tissue containing blood vessels in an arrangement similar to the Dentin-Pulp complex found in normal human teeth. These cells had a high proliferative capacity, a self renewal property and a multi-lineage differentiation potential.[4]

Laino et al[2] isolated a selected subpopulation of DPSCs known as Stromal Bone-producing Dental Pulp Stem Cells (SBP-DPSCs). These were described as multipotential cells that were able to give rise to a variety of cell types and tissues including osteoblasts, adipocytes, myoblasts, endotheliocytes, and melanocytes, as well as neural cell progenitors (neurons and glia), being of neural crest origin.

They are multipotent stromal cells that proliferate extensively, can be safely cryopreserved, are applicable with several scaffolds, have a long lifespan, possess immunosuppressive properties, and are capable of forming mineralized tissues similar to dentin.[6]

SHED

SHED were isolated for the first time in 2003 by Miura et al, who confirmed that they were able to differentiate into a variety of cell types to a greater extent than DPSCs, including neural cells, adipocytes, osteoblast-like and odontoblast-like cells.[7] The use of SHED for tissue engineering might be more advantageous than that of stem cells from adult human teeth; they were reported to have a higher proliferation rate than stem cells from permanent teeth, and can also be retrieved from a tissue that is disposable and readily accessible. Thus, they are ideally suited for young patients at the mixed dentition stage who have suffered pulp necrosis in immature permanent teeth as a consequence of trauma.

SCAP

A new unique population of mesenchymal stem cells (MSCs) residing in the apical papilla of permanent immature teeth, known as stem cells from the apical papilla (SCAP), were recently discovered by Sonoyama et al [9]. SCAP are capable of forming odontoblast-like cells, producing dentin *in vivo*. The discovery of stem cells in the apical papilla may also explain a clinical phenomenon described in a number of recent clinical case reports showing that apexogenesis can occur in infected immature permanent teeth with periradicular periodontitis or abscess. It is likely that the SCAP residing in the apical papilla survive such pulp necrosis because of their proximity to the vasculature of the periapical tissues. Therefore, after endodontic disinfection, and under the influence of the surviving epithelial root sheath of Hertwig, these cells can generate primary odontoblasts that complete root formation.

Periodontal ligament stem cells (PDLSCs)

Seo et al. described the presence of multipotent postnatal stem cells in the human PDL (PDLSCs). Under defined culture conditions, PDLSCs differentiated into cementoblast-like cells, adipocytes, and collagen-forming cells. When transplanted into immunocompromised rodents, PDLSCs showed the capacity to generate a cementum/PDL-like structure and contributed to periodontal tissue repair.

Recently, Trubiani et al. suggested that PDLSCs had regenerative potential when seeded onto a threedimensional biocompatible scaffold, thus encouraging their use in graft biomaterials for bone tissue engineering in regenerative dentistry. Li et al. have reported cementum and periodontal ligament-like tissue formation when PDLSCs are seeded on bioengineered dentin.

Stem Cell Identification

Stem cells can be identified and isolated from mixed cell populations by four commonly used techniques:

(a) Staining the cells with specific antibody markers and using a flow cytometer, in a process called fluorescent antibody cell sorting (FACS); (b) immunomagnetic bead selection; (c) immunohisto-chemical staining; and (d) physiological and histological criteria, including phenotype (appearance), chemotaxis, proliferation, differentiation, and mineralizing activity. FACS together with the protein marker CD34 is widely used to separate human stem cells expressing CD34 from peripheral blood, umbilical cord blood, and cell cultures Human pulp stem cells express von Willebrand factor CD146, alpha-smooth muscle actin, and 3G5 proteins. Human pulp stem cells also have a fibroblast phenoptype, with specific proliferation, differentiation, and mineralizing activity patterns[11,12]

Culturing of stem cells

A successful stem cell culture is one that keeps the cells healthy, dividing, and unspecialized.

Dental pulp stem cells can be cultured by two methods;

Enzyme-digestion method: The pulp tissue is collected under sterile conditions, digested with appropriate enzymes, and then the resulting cell suspensions are seeded in culture dishes containing a special medium supplemented with necessary additives and incubated. Finally, the resulting colonies are sub cultured before confluence and the cells are stimulated to differentiate.

Second method is the *Explant outgrowth method* in which the extruded pulp tissues are cut into 2-mm3 cubes, anchored via microcarriers onto a suitable substrate, and directly incubated in culture dishes containing the essential medium with supplements. Ample time (up to 2 weeks) is needed to allow a sufficient number of cells to migrate out of the tissues.[13]

Haung et al compared both methods and found that cells isolated by enzyme-digestion had a higher proliferation rate than those isolated by outgrowth.

Growth factors

Growth factors are extracellularly secreted signals governing morphogenesis /organogenesis during epithelialmesenchymal interactions. They regulate the division or specialization of stem cells to the desirable cell type, and mediate key cellular events in tissue regeneration including cell proliferation, chemotaxis, differentiation, and matrix synthesis.

Some growth factors are used to increase stem cell numbers, as is the case for platelet-derived growth factor

(PDGF), fibroblast growth factor (FGF), insulin-like growth factor (IGF), colony-stimulating factor (CSF) and epidermal growth factor (EGF). Others modulate the humoral and cellular immune responses (interleukins 1- 13) while others are important regulators of angiogenesis, such as vascular endothelial growth factor (VEGF), or are important for wound healing and tissue regeneration/ engineering, such as transforming growth factor alpha and beta. One distinct family of growth factors implicated in tooth development and regeneration are the bone morphogenetic proteins (BMPs).

Bone morphogenetic proteins (BMPs)

Bone morphogenetic proteins are multi-functional growth factors belonging to the transforming growth factor superfamily. To date, about 20 BMP family members have been identified and characterized. They have different profiles of expression, different affinities for receptors and therefore unique biological activities *in vivo*. They play a vital role in the formation of dental hard tissues. During the formation of teeth, BMPs dictate when initiation, morphogenesis, cytodifferentiation, and matrix secretion will occur.

BMPs, as well as other growth factors, have been successfully used for direct pulp capping. This has encouraged the addition of growth factors to stem cells to accomplish tissue engineering replacement of diseased tooth tissues.

BMPs finds application either *in vivo* therapy, where BMPs or BMP genes are directly applied to the exposed or amputated pulp or *ex vivo* therapy, which consists of isolation of DPSCs, their differentiation into odontoblasts with recombinant BMPs or BMP genes, and finally their autogenous transplantation to regenerate dentin.

Recombinant human BMP-2 stimulates the differentiation of adult pulp stem cells into odontoblast-like cells in culture, increases their alkaline phosphatase activity and accelerates expression of the dentin sialophosphoprotein (DSPP) gene in vitro, and enhances hard tissue formation in vivo. Also, autogenous transplantation of BMP-2-treated pellet culture onto amputated pulp stimulates reparative dentin formation.

Similar effects have been demonstrated for BMP-7, which promotes reparative dentinogenesis and pulp mineralization[2]

Scaffolds A scaffold can be implanted alone or in combination with stem cells and growth factors to provide a physicochemical and biological three-dimensional microenvironment or tissue construct for cell growth and differentiation

Ideal requirements of a scaffold

(a) Should be porous to allow placement of cells and growth factors.

(b) Should allow effective transport of nutrients, oxygen, and waste.

(c) Should be biodegradable, leaving no toxic byproducts.

(d) Should be replaced by regenerative tissue while retaining the shape and form of the final tissue structure.

(e) Should be biocompatible.

(f) Should have adequate physical and mechanical strength.

Types of scaffold

a) Biological/natural scaffolds

These consist of natural polymers such as collagen and glycosaminoglycan, which offer good biocompatibility and bioactivity. Collagen is the major component of the extracellular matrix and provides great tensile strength to tissues. As a scaffold, collagen allows easy placement of cells and growth factors and

allows replacement with natural tissues after undergoing degradation. However, it has been reported that pulp cells in collagen matrices undergo marked contraction, which might affect pulp tissue regeneration.[14.]

b) Artificial scaffolds

These are synthetic polymers with controlled physicochemical features such as degradation rate, microstructure, and mechanical strength, for example:

- Polylactic acid (PLA), Polyglycolic acid (PGA), and their copolymers, Poly lactic-co-glycolic acid (PLGA).
- Synthetic hydrogels include polyethylene glycol (PEG)- based polymers.
- Scaffolds modified with cell surface adhesion peptides, such as arginine, glycine, and aspartic acid (RGD) to improve cell adhesion and matrix synthesis within the three-dimensional network.
- Scaffolds containing inorganic compounds such as hydroxyapatite (HA), tricalcium phosphate (TCP) and calcium polyphosphate (CPP), which are used to enhance bone conductivity, and have proved to be very effective for tissue engineering of DPSCs
- Micro-cavity-filled scaffolds to enhance cell adhesion.

Scaffolds for tissue engineering

Pulp cells can be isolated, multiplied in culture, and seeded onto a matrix scaffold where the cultured cells form a new tissue similar to that of the native pulp. However, when implanting cells/scaffolds into root canals that have a blood supply only from the apical end, enhanced vascularization is needed in order to support the vitality of the implanted cells in the scaffold. This can be optimized with the addition of growth factors such as VEGF and/or platelet-derived growth factor or, further, with the addition of endothelial cells. Through the use of computer-aided design and three-dimensional printing technologies, scaffolds can be fabricated into precise geometries with a wide range of bioactive surfaces. Such scaffolds have the potential to provide environments conducive to the growth of specific cell types.[14]

Maturogenesis

A number of recent clinical case reports[15,16] have suggested that many teeth that would traditionally have undergone apexification may be treated by apexogenesis. Although Iwaya et al. [16] and Banchs and Trope [15]applied the term 'revascularization' to describe this phenomenon, what actually occurred was physiological tissue formation and regeneration. This may be attributed to SCAP surviving the infection and contributing to this phenomenon. It is also possible that the radiographic presentation of increased dentinal wall thickness might be due to in growth of cementum, bone, or a dentin-like material.

The key procedures of the new protocol suggested for treating non-vital immature permanent teeth are

(1) minimal or no instrumentation of the canal while relying on gentle but thorough irrigation of the canal system with sodium hypochlorite and chlorohexidine, (2) augmented disinfection by intra-canal medication with a triple-antibiotic paste (containing equal proportions of ciprofloxacin, metronidazol, and minocycline in a paste form at a concentration of 20 mg/ml) between appointment, and (3) sealing of the treated tooth with mineral trioxide aggregate (MTA) and glass ionomer/resin cement upon completion of the treatment. Finally, periodical follow-ups are made to observe any continued maturation of the root.[1,2,15,16]

Some investigators have induced hemorrhage in the pulp space by over-instrumentation[3,15], Allowing a blood clot to form in the canal. Then MTA was placed over the blood clot. They considered that the initiation of a blood clot would provide a fibrin scaffold containing platelet-derived growth factors that would promote the regeneration of tissue within the root canal system. The induction of bleeding to facilitate healing is a common surgical procedure. It had been proposed earlier by Ostby and Myers and Fountain[17] to guide tissue repair in the canal. However, there is a lack of histological evidence that a blood clot is required for the formation of repaired tissues in the canal space[2]. Moreover, there have been no systematic clinical studies to indicate that application of this approach gives significantly better results than procedures that lack it. There is no current evidence-based guideline to help clinicians determine the types of cases that can be treated with this conservative approach. The presence of radiolucency in the periradicular region can no longer be used as a determining factor, nor can the vitality test be used. In both situations, vital pulp tissue or an apical papilla may still be present in the canal and at the apex. Clinicians are urged to consider choosing a conservative approach first, while apexification can be performed in cases of failure [1,2,3,15,16]

Future trends

With our improved knowledge in stem cell research and tissue engineering concepts, a new path has been set towards a more conservative approach and we have succeeded in revitalizing immature non vital teeth. Though various potential technologies are suggested, most are confined to laboratory or in vitro studies. One of the most challenging aspects of developing regenerative endodontic therapy is to understand how various component procedures can be optimized and integrated to produce the outcome of regenerated pulp

dentin complex[3]. Current research explores the perfect blending of the key factors, reliable autogenous stem cell source, appropriate signaling molecules and scaffolds that promote controlled cell growth and differentiation.

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Review

Alveolar decortication as a part of pre-orthodontic periodontal therapy

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Abstract

The dental disciplines of orthodontics and periodontics go hand in hand. The development of new treatment options in periodontics and orthodontics, offer symbiotic ways in treatment of periodontally affected patients where the orthodontic treatment aims at providing functional occlusion and is strongly related to interactions of teeth with their supportive periodontal tissues. Much has been discussed about the role of orthodontic therapy in periodontics. Very few have discussed the vice versa. This literature review attempts to outline the role of alveolar decortication as a part of pre-orthodontic periodontal therapy.

Introduction

There has been a tremendous increase in the number of adult patients seeking orthodontic treatment in the recent years. This group of patients should be dealt with caution because improper periodontal examination in them could result in poorly executed orthodontic treatment. In particular, the combination of inflammation, orthodontic forces, and occlusal trauma may produce a more rapid destruction than would occur with inflammation alone.

It is essential for an orthodontist to examine the periodontium in detail before attempting treatment for an adult patient. A periodontal screening and recording would be beneficial in them. Probing the gingival sulcus, checking for the width of attached gingiva watching out for plaque and plaque retentive areas, the compliance of the patient in maintaining good oral hygiene, parafunctional habits etc can be looked for. The help of a periodontist may be needed in several of these instances. There are several instances where pre-orthodontic periodontal therapies need to initiated. One such procedure is alveolar decortication.

Pre- orthodontic periodontal therapy

The treatment of atrophied hard and soft tissues of the diseased periodontium prior to orthodontic therapy has been elucidated in the literature. Atrophy of the alveolar bone ridge is a frequent consequence of periodontitis, tooth extraction etc. The correction of the atrophied bone had been attempted through various procedures, on among them being lengthening the atrophied bone to its earlier dimension by a procedure called distraction osteogenesis (DO). DO is a biologic process that stimulates the formation of new bone following the gradual separation of two bone segments previously joined together.

The concept of distraction osteogenesis was introduced nearly 100 years ago[1] by Codivilla who reported the lengthening of a femur, a long bone. The method wasn't widely employed until the 1950s, when Russian orthopedic surgeon Dr. Gabriel Ilizarov perfected the technique. Dr. Ilizarov performed an *osteotomy* –intending to lengthen an amputated bone stump with a bone graft in the middle. He then put a metal frame around the stump, creating a gap - technically called a "distraction gap." He later noticed that the new bone grew in the distraction gap, eliminating the need for the bone graft. Intrigued, Dr. Ilizarov researched the phenomenon and proved that stressing a bone increases metabolic activity and cellular generation, also known in orthopedic science as "bone remodeling," resulting in growth of new bone. This phenomenon was named Distraction Osteogenesis (DO) – growth of new bone by means of surgically "distracting" the bone. Later transverse growth[2] of lone bones was also appreciated through DO.

As early as the 1950s, Periodontists began using a technique called *corticotomy* on the alveolar bone to increase the rate of tooth movement. Decortication was done ostensibly to enhance the healing process by promoting bleeding and allowing progenitor cells and blood vessels to reach a bone grafted site more readily[3]. In addition, decortication improved the physical bond between grafted bone and a recipient site[4].

In the early 1960s, craniofacial surgeons began using DO techniques to rapidly expand palates in growing patients. In the 1970s, the first reported use of DO in maxillofacial field was on a canine mandible[5]. Since then multiple reports have been published on the role of DO in the craniofacial field. During the next two decades, interest in craniofacial distraction grew slowly and sporadic experiments were performed, mainly on dogs. In the early 1990s, the technique began to be more

widely used on human patients with jaw defects. DO in pre-prosthetic field was introduced by Chin and Toth[6] in 1990s with vertical ridge augmentation for dental implants[7, 8] being a new addition to it.

Meanwhile, distinguished orthopedist Harold Frost realized that there was a direct correlation between the degree of injuring a bone and the intensity of its healing response. He called this the *Rapid Acceleratory Phenomenon* (RAP). In RAP, there is a temporary burst of localized soft and hard tissue remodeling (i.e., regeneration) which rebuilds the bone back to its normal state. It denotes that there is a local exuberant response to noxious stimuli, which accelerates the normal healing process. Relevantly, decortication of alveolar bone can be considered a noxious stimulus; Winet[9] noted that vascularity peaked after trauma to the bone and declined to normal levels after healing was completed. Application of this concept is being used as a method to facilitate rapid orthodontic movement.[10, 11] In particular, selective alveolar decortication is used to initiate local tissue repair and release of osteoprogenitor cells and osteoinductive agents.[11]

In the 1990s, the Drs. Thomas and William Wilcko, of Erie, PA (Thomas Wilcko is a Periodontist and his brother, William Wilcko, is an Orthodontist) using computed tomography, discovered that reduced mineralization of the Alveolar bone was the reason behind the rapid tooth movement following corticotomies. Both were interested in methods of growing bones called Distraction Osteogenesis and Regional Accelerated Phenomenon (RAP), and modified these methods to work orthodontically with limited trauma to the surgical site. They used their knowledge of corticotomy, and their observations of RAP, to develop their patented "Accelerated Osteogenic Orthodontics / wilckodontics" (AOO) technique in 1995.

AOO incorporates selective decortications of the alveolar bone thereby exposing the cancellous bone. This creates a transient osteopenia and high bone turn over in sites adjacent to the injury site. This healing response depends upon the proximity to and the intensity of the surgical site. Several studies reported similar observation in alveolar bone following tooth extraction[12], after tooth movement[13] and after alveolar periosteal flap elevation. In 2001, Wilcko et al described selective decortication with augmentation bone grafting combined with orthodontic therapy. They patented the technique as "Periodontally Accelerated Osteogenic Orthodontics (PAOO)."[10]

PAOO employs raising a full thickness mucoperiosteal flap adjacent to teeth intended for movement. Selective decortications is performed based on the thickness of the cortical plates. The depth of decortications barely penetrating in to the medullary bone and bleeding is promoted after taking into consideration minimal trauma to teeth and periodontal ligament. An allograft of resorbable grafting material is placed over the bone and the surgical wound is closed with sutures. The grafting procedure is done without membranes because full-thickness flaps are used followed by primary closure in a healthy periodontium. Under these circumstances, migration of the epithelial attachment is not likely to occur, and the intact periosteum serves as a natural "membrane."

The indications of PAOO includes: correction of dehiscence and fenestrations, accelerated treatment time for orthodontic procedures, rapid recovery of impacted teeth etc. The contributions of periodontal therapy to orthodontic treatment through PAOO is to increase alveolar volume and enhance the periodontium, enhance the stability of orthodontic clinical outcomes (less relapse), increase the scope of malocclusion treatable, and reduce active orthodontic treatment time over 3-fold. These benefits are realized for two reasons: (1) tissues lose memory due to high hard and soft tissue turnover induced by the periodontal decortication, and (2) augmentation bone grafting increases alveolar volume and thickness of the alveolar cortices.

Biologic rationale of PAOO

Alveolar distraction osteogenesis appears to be an extremely promising technique to correct alveolar deformities. DO allows the augmentation of alveolar bone with new bone formation and obtains a significant increase in the surrounding soft tissues, with low morbidity, infection rates and significant shorter waiting period for rehabilitation.[14, 15]

Drilling holes through cortical bone into more vascular cancellous bone induces bleeding that immerses the bone graft site in blood. As the clot organizes, it releases cytokines and growth factors to attract progenitor cells, osteoblasts, and blood vessels.[16, 17] Decortication of bone may provide passageways for blood vessels and progenitor cells to have rapid access to a treated site. It is believed that creating perforations in the bone mimics what occurs during bone remodeling when osteoclastic cutting cones radially penetrate the bone. Ultimately, the bone needs to resorb and create blood vessel channels or remodel around Volkmann's vascular canals to allow access for new blood vessels.[18] This facilitates capillary ingrowth that precedes bone deposition.[18]

It is recognized that osteoblasts are responsible for new bone formation and are derived from the periosteum, endosteum, and undifferentiated pluripotential mesenchymal cells in the bone marrow.[19] It is theorized that decortication of intact bone may speed up the process of getting blood vessels, osteoblasts, and pluripotential cells to grafted sites.[3]

Perforating the bony cortex also may increase the

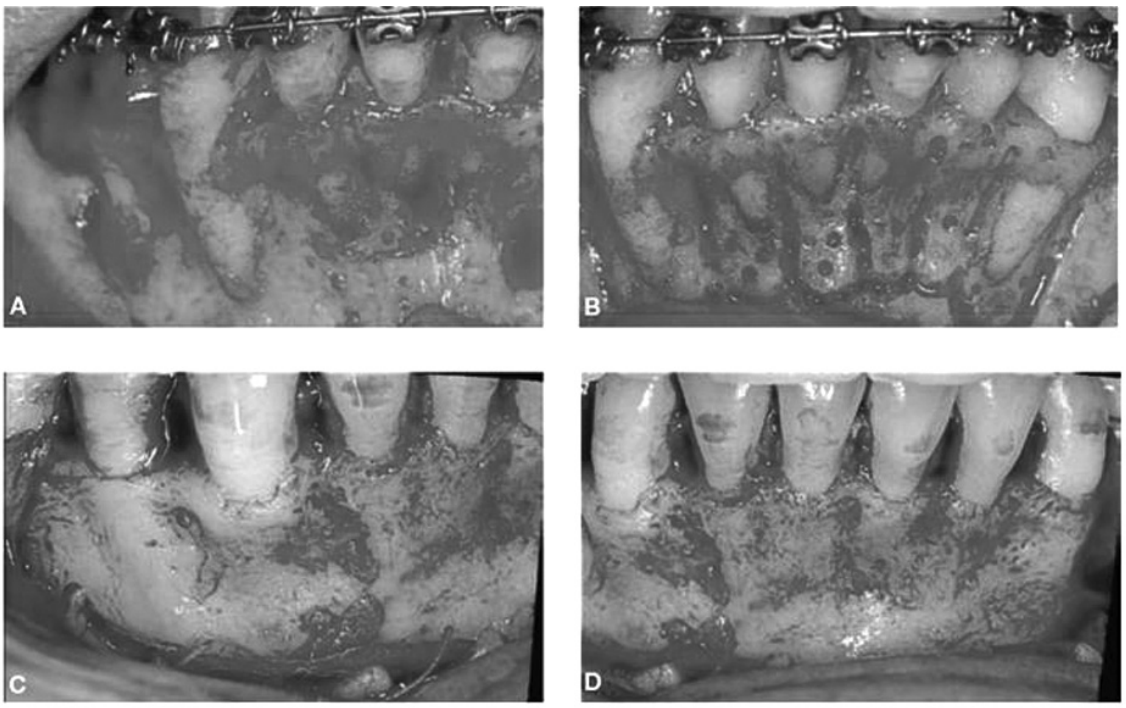

Fig. 1 PAOO for treating alveolar dehiscences as a part of pre orthodontic periodontal therapy
A) Bone dehisence present after raising a full thickness flap; B) Selective alveolar decortications prior to grafting
C& D) 7.5 years post PAOO
Adapted from SIERGE DIBART : PRACTICAL ADVANCED PERIODONTAL SURGERY
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mechanical interlocking of a bone graft and a recipient site, which may improve its stability and provide firm linking for newly regenerated bone.[4] The new bone created by DO exhibits a predominant membraneous pathway[20] for its formation. With respect to the spacing of bone perforations to attain the maximum benefit, this subject has never been addressed in the literature.

Assessing the effect of decortication on regeneration of bone: Animal and histologic studies in the dental literature

In general, there are limited and conflicting data derived from controlled clinical trials in animal models with respect to the affects of decortications. The available data are difficult to compare because investigations used different animal models, reevaluated sites at different time intervals, attempted to regenerate different heights and widths of bone, and the results were reported as an overall percentage gain of bone, which did not differentiate between the width and height of bone. Data confirming that decortication enhanced bone regeneration has been ascertained in studies[21, 22] conducted in rabbit and rat animal models. While few reports[23] had conflicting results that decortication did not enhance bone healing.

Only one controlled study was found that addressed the impact of the size of decortications on bone regeneration. Nishimura et al.[24] evaluated whether the size of the openings through the cortex altered the outcome. They created bone defects in two sizes (slits in bone): 1 · 15 mm and 3 · 15 mm. Initially, the larger slits were associated with faster and more new bone formation compared to the smaller perforations. However, no difference was noted in the amount of bone regenerated 12 weeks after therapy.

Animal studies on rats and rabbits are often used because they are easy to anesthetize, inexpensive to buy, easy to maintain, and require little space for caging. The disadvantage is that they belong to low-order phylogenetic species with a characteristically high potential for osteogenesis. The rate of osseous formation seems to vary inversely with the species' position on the phylogenetic scale. Therefore, it is difficult to extrapolate experimental results relative to the rate and amount of bone regeneration from animal models to humans. Nevertheless, the fundamental physiology of bone repair and regeneration is similar in these animals and humans. Accordingly, it may be reasonable to suggest that the positive effects of decortication in accelerating healing or enhancing the volume of bone regeneration in experimental animal models can be obtained in humans.

PAOO increases the scope of orthodontic tooth

movement and the position of teeth after decortications and augmentation grafting are stable on a long term basis. PAOO has contributed greater stability of orthodontic clinical outcomes and less relapse. Rothe et al. (2006)[25] found that patients with thinner mandibular cortices were at increased risk for having dental relapse-hence the necessity for osseous grafting during the PAOO procedure.

Conclusions

The contributions of periodontal therapy to orthodontic treatment through PAOO is to enhance the periodontium, enhance the stability of orthodontic clinical outcomes and increase the scope of malocclusion treatable, to reduce active orthodontic treatment time over 3-fold. Decortication may help to physically interlock new bone and remaining graft material to the recipient site. Decortication may provide a quicker healing response; however, the data are limited to support this contention. Decortication may facilitate regenerating more bone, as per several controlled clinical trials in animals. However, there are other investigations that noted that successful results can be attained without decortication. Therefore, conflicting information precludes making a definitive statement that decortication results in improved outcomes. More human clinical trials have to be done to determine whether decortication enhances alveolar bone augmentation.

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History taking for anesthesia in children

*** Jyoti Issac, ** Sageena George**

Dental procedures in children surface as a complicated task to the practicing clinician, needing much patience to tactfully handle the little ones. Extremely uncooperative children, children with moderate to severe behavioural problems, mentally retarded patients, autistic/ADHD (Attention Deficit Hyperactive Disorder) children generally present themselves as a dilemma to even the most experienced of dental surgeons. In almost all cases, dental doctors seek the advice of a Pediatric dentist to enquire about the possibility of treating the patient under conscious sedation/ general anesthesia. Hence it is vital to update on one's knowledge of the detailed history taking that is mandatory, for referral of a child patient to the Pedodontist for complete oral rehabilitation under ambulatory anesthesia.

The term *Anesthesia* is derived from Greek meaning insensible or without feeling. In the early 1900's American anesthesiologist Ralph Waters, opened his Downtown anesthesia clinic in Sioux City, Iowa. This facility which provided care for dental and minor surgery cases is generally regarded as the proto type for the modern anesthetic ambulatory unit.

Factors in selection of the patient: Criteria for outpatient surgery are mainly based on three factors: the nature of the operative procedure, parental readiness and patient status. Surgical procedures suitable for ambulatory surgery should be accompanied by minimal post operative physiologic impairment and uncomplicated recovery. Most patients selected for ambulatory surgery are ASA-PS I or II***. However, with improved anesthesia care, ASA class III is also able to undergo surgery. As part of patient selection, the dentist must evaluate patient's physical and emotional status and then decide which type of anesthesia is required.

***ASA – PS classification: The American society of Anesthesiologists Physical Status categories: Class I Normally healthy with no underlying disease, Class II - Mild disease or moderate systemic disease that is well controlled and does not interfere with routine activities, Class III- Severe disease with functional impairment, Class IV- Life – threatening disease, Class V Life – threatening disease with instability, high risk of death even with medical intervention.

Special attention to the following is critical to the appropriateness of the decision for sedation of a patient. (a) Past medical illnesses and chronic conditions (b) Prior surgeries (c) Current and recent medications taken, Any Allergies (d) Past experiences with sedation, analgesia and tracheal intubations (e) Neurologic disease, Asthma or other lower airway disease (f) Sickle cell disease, Anemia (g) Cardiac disease, Renal or hepatic impairment (h) Gastroesophageal reflux diseases (i) NPO status - Elective procedures should be postponed if the patient has not observed recommended NPO guidelines

General inspection

Clinical examination of a child begins from the moment of first meeting. Child's appearance, demeanor, state of nutrition, reaction to the environment, speech, cry, size relative to age, state of nutrition, state of activity, posture, overt deformity, any injury ?

History taking

A complete history is not only necessary but leads to the correct diagnosis in the vast majority of patients. Expanding the question of "why did you bring him?" to "what concerns you?" allows the informant to focus on the complaint more accurately. The specific points for enquiry of History Of Presenting Illness are: *Symptoms* complained of and their duration, preferably in a precise order, including any repeated episodes. *Changes noted* since the onset of the present illness, contrasting the present with previous condition. *Activity of the child* - Child's movement, performance in normal house hold activities, interest in people and things, willingness to walk to school or shops, tiring easily or returning early from play. *Difficulty in swallowing*: Does he choke or gag when he has food? Does he swallow food and regurgitate it shortly thereafter? *Vomiting:* Amount, frequency, duration effortless or projectile, nature of vomitus (Stained with blood), Is it associated with abdominal pain (eg: Appendicitis) diarrhoea, constipation, pyrexia or impairment of consciousness? *Abdominal pain:* This is one problem which occurs more frequently in children - ascertain it's nature, timing, duration, constancy or intermittency, site, aggravation by breathing or movement, relationship to food, bowel movement or micturition, association with anorexia, diarrhoea, constipation, vomiting, sore throat, cough etc. *Loss or gain in weight:* Thinner or fatter judged by general appearance, wasting, swelling or puffiness? *Discharge from eyes, ears, nose or other sites:* Purulent, watery or blood

stained, profuse or scanty. *Cough:* Ascertain the duration, character, dry or moist, more severe by day or night; disturbance of sleep. *Breathlessness:* Present only on activity or at rest, persistent or intermittent, of gradual or sudden onset. *Cry or voice:* Any change noted? *Mouth breathing:* Mouth habitually open or short, snores? Any Tongue – thrusting or Cheek – biting or thumb sucking habits? *Wheezing:* Inspiratory or expiratory, continuous or intermittent. *Localized swellings:* Site, size, color, consistency, presence or absence of local pain, tenderness, duration of the swelling. *Rashes or skin lesions. State of musculature:* Normal active movements or not? Does the mother feel the limbs to be stiff or floppy, slipping through her hands on lifting? *Changes in posture or in walk:* Of long duration or recently developed; holding the body in an unusual way; abnormality in gait. *Co-ordination:* Dropping things; spilling from a cup, impairment of fine movement. *Involuntary movements:* Nature of these, the same movement repeated or different movements? What intervals? How long? *Speech:* Delay in onset or loss of speech, change in character etc. *Any convulsion or fits:* Any precipitating factor, any symptoms prior to duration of various stages, state of consciousness. Loss of posture, up rolling of eyes, biting of tongue or other injury, sleep or headache after the convulsive disorder? *Defects in vision:* Able to follow a moving object with eyes, difficulty in reading or distance vision. *Head ache:* Site, manner of onset, severity *Hearing:* Unresponsiveness or inattentiveness, any evidence of mental retardation, behaviour disorder etc. *Behaviour and mood:* Active or hypoactive, Quiet or lethargic, disobedient or aggressive, reluctant to go to school, refusal of food; withdrawn from others, averse to social activities, fearful of darkness; temper tantrums, carefree or anxious, nagging, demanding attention, fastidious or careless, crying too readily., relationship with parents, siblings, schoolmates.

Selectivity of questioning: Not all of the questions indicated above will be asked in every instance, some will be secondary questions dependant on positive answers to primary questions. Better to ask too many rather than too few questions. The more extensive the questioning the more likely are forgotten points of history to be revealed.

Birth history: Ascertain illnesses which the mother had before or during pregnancy, exposure to drugs or radiation, hypertension, diabetes, edema, threatened abortion, length of gestation, duration of labour (prolonged?) type of delivery? Number of previous pregnancies. Note the infants' birth weight, state at delivery and postnatal history such as convulsion, breathing difficulties, vomiting etc.

Feeding history: Whether the baby was breast or bottle fed and how well the baby took the first feeding. Poor sucking at the first feeding may be due to sleepiness or can be a sign of neurologic abnormality. Determine the age of introduction of solid foods and the supplementation with vitamins or fluorides. Also whether the child had any previous illness, its duration and severity.

Developmental History: Estimation of physical growth rate, any sudden gain or loss should be noted. Ages of major developmental milestones.

Immunization history: Types of immunizations, site given and reactions should be recorded as part of history.

Final comment

History taking for children has been rather a *forgotten art* by most clinicians. "T.L.C." or Tender-Loving-Care is perhaps one of the most important "tricks" in our bag, yet one that is the most neglected. Too often one loses sight of the person that is on the receiving end of the instruments and techniques, and forgets that even the "Special" child with physical and mental limitations, is still a child, is still capable of feelings. To ensure that the tiny- tots receive the best possible care, it is important to record the major/minor details pertaining to each one.

Because children presenting for surgery may have complex medical conditions also, in addition to dental problems, the general practitioner must play an active role in their proper preoperative assessment, preparation and uncomplicated recovery.

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V Taper: Rotary files

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Abstract

Over the last few years endodontics has undergone a complete revolution with the introduction of the NiTi alloy for the manufacture of initially manual and then rotary endodontic instruments. Nickel Titanium based rotary systems are evolving by the day as newer systems are introduced to the market. These newer systems provide improved clinical performance and fewer complications in cleaning and shaping. This article reviews NiTi rotary instruments in general and V taper system that has been recently introduced. The V taper files have a Variable decreasing rate of taper starting at the tip going towards the shaft unlike constant tapered files.

Introduction

The NiTi alloy came to the fore when used at the beginning of the 60's by W. H. Buehler in a space program of the Naval Ordnance Laboratory at Silversprings, Maryland, USA. The alloy was called Nitinol, an acronym for the elements from which the material was composed:ni for nickel, ti for Titanium and nol from the Naval Ordinance Laboratory. It was introduced into dentistry in 1971 by Andreasen in order to create orthodontic wires. The NiTi alloy belongs to the family of the Nickel and Titanium intermetallic alloys, characterized by two properties which distinguish them, the memory of shape and superelasticity

Ground rotary nickel titanium (RNT) files became commercially available in the early 1990s and today are the predominant method for cleaning and shaping root canals. RNT files offer a predictable, systematic and effective instrumentation method when used appropriately. During instrumentation, they transform from an austenite crystalline structure to a martensite crystalline structure upon application of mechanical stress, and transform back to the austenite form when the stress is removed. RNT files are typically used in a Crown Down technique whereby the sequence of instrumentation starts from the largest file used to the smallest file used. The crown down technique minimizes the extrusion of debris periapically, thus reducing postoperative sensitivity and allows better dissolution and removal of contaminated and infected tissues from pulp space by the irrigants. Clinicians must use an appropriate technique and discard files after a few uses to avoid file fracture which, while occurring in a very small minority of cases and varying with the technique used, is a concern due to its sudden and unpredictable nature during endodontic procedures.[1]

File fracture and separation may occur due to flexural failure or torsional force, which are known to occur along microcracks that are produced during the grinding of NiTi files. Torsional fracture occurs when an instrument tip or another part of the instrument is locked in a canal while the shank continues to rotate.[6,7] Instruments fractured because of torsional loads often carry specific signs such as plastic deformation. Fracture caused by fatigue through flexure occurs because of metal fatigue. The instrument does not bind in the canal, but it rotates freely in a curvature, generating tension/compression cycles at the point of maximum flexure until the fracture occurs. As an instrument is held in a static position and continues to rotate, one half of the instrument shaft on the outside of the curve is in tension, whereas the half of the shaft on the inside of the curve is in compression. This repeated tension-compression cycle, caused by rotation within curved canals, increases cyclic fatigue of the instrument overtime and may be an important factor in instrument fracture.

Electropolishing is one of the treatments that has been introduced to reduce surface defects such as microcracks and grooves, and has been found to increase resistance to fracture of RNT and metal rollover, while simultaneously dulling the cutting edges. Recent studies have found that electropolishing improves resistance to cyclic fatigue and torsional loading which will increase resistance to fracture. Larger diameter files resist torsion better than smaller diameter files, and smaller files resist cyclic fatigue better than larger diameter files.[5,9]

Performing endodontics using constant-tapered instruments can result in inconsistent preparation of the pulp space, because canals do not have a constant taper the coronal 2/3rd of the canal can be over-prepared, while the apical 1/3rd can be underprepared. Often, use of constant-tapered instruments calls for an increased number of instruments, which can increase the procedural costs. The V-Taper instruments introduced by Charles J Goodis, have Variable decreasing rate of

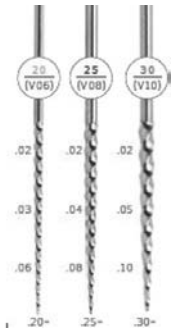

Fig 1. V taper files

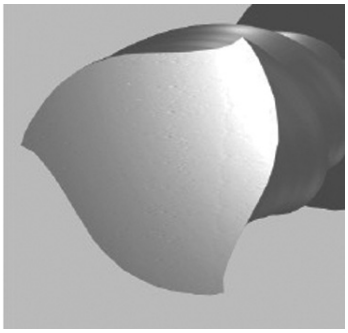

Fig 2. Parabolic Cross Section

taper starting at the tip going up towards the shaft. The variable taper increases, but not as quickly as a constant tapered file. For example, the V10 taper from 0 to 4 mm has a 10% taper, from 4 to 8 mm has a 5% taper, and from 8 to 12 mm has a 2% taper (Fig 1). This enables to attain deeper apical shapes with a more conservative access using fewer instruments.

Features

The V-Taper Rotary System is a series of three variable taper NiTi rotary files. Vtaper files have a parabolic cross section (fig2). The variable pitch eliminates screw in effect. Neutral rake angle and absence of radial lands reduces heat buildup and dragging. Non cutting tip prevents ledging and transportation.

Advantages

1. Less number of instruments required
2. More conservative preparation
3. Cost efficient
4. Matched gutta-percha points
5. Reduced chance for strip perforations

Initial setup

The glide-path. Before shaping the canal with NiTi rotary instruments, preparing a glide-path is needed to significantly reduce the stress on the instruments due to canal irregularities and calcification. The glide path phase entails irrigating with Aqueous 17% Ethylenediaminetetraacetic acid (EDTA), then instrumenting with a #10 (and optional #15) hand files to the working length for safer, easier use of NiTi rotary instruments.

Shaping and cleaning phase

Variable-tapered NiTi rotary files are used to shape the canal, removing infected dentin and pulpal tissue and allowing irrigants proper access to clean the canal. The V-Taper System is used in a crown-down technique going from larger to smaller files. For every size canal, start with the size #30, down to the size #25, then down to size #20. This first removes any coronal irregularities, thereby reducing the resistance and stress on endodontic files. The #30 (VI0) is used in place of multiple Gates Glidden burs to shape the coronal 2/3 of the canal for small and medium canals. In large canals, the #30 (V10) can be taken to length. This allows the V-Taper System to achieve conservative coronal 2/3 shaping.

Deep apical 1/3 shaping

After conservative coronal 2/3 shaping, deep apical 1/3 shaping is done by continuing the irrigation and crown-down rotary preparation with NaOCl, then using one to three rotary files, and repeating until the apical terminus is increased to the needed shape. Because of the variable taper, after the #25 (V08) is taken to the working length, if needed, an increase in file size to a larger V-Taper file can be done—i.e., from #25 (V08) to #40 (V06). Larger apical preparations increase bacterial removal.

Obturation

Custom matching gutta-percha points are available with the system. After completing the cleaning and shaping, gutta percha point that matches the largest file is taken to the working length. It is acceptable to go up or drop down a size. Obturation is completed using a vertical, lateral or single cone technique. If a 04 or06 cone or themal carrier device is preferred, use the largest cone or device that will go to length.

Conclusion

The V taper files provide better apical access with a more conservative access preparation, preserving the radicular dentin. This technique allows for the minimally invasive shaping, cleaning, and disinfecting of the root canal system to remove bacteria and create better access for irrigants and obturation materials while conserving coronal 2/3 root structure to prevent vertical root fractures.[2,3,4]

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Dental derived stem cells: Potential therapeutics for regeneration

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Abstract

This paper is concerned about dental-derived stem cells and their characterization in vitro and in vivo. The recent identification of different stem residing in dental tissues expands the scope of potential clinical benefits of mesenchymal stem cells to help regenerate other connective tissues such as dentin, cementum, and periodontal ligament.

Introduction

The discovery of stem cells has led to a revolution in modern medicine. Stem cells also known as "progenitor" or "precursor" cells, are defined as clonogenic cells capable of both self-renewal and multi-lineage differentiation.[1] Stem cells are the basic cells of our bodies which can develop and differentiate into any type of cell. Stem cells are the foundation cells of every organ, tissue and every cell of our body. The first stem cell originates within the developing embryo.

The sources of stem cells are

1. Embryonic stem cell: The human embryonic stem cells are derived from 4–5 day-old embryo prior to its implantation in the uterus; this stage of embryo is known as blastocyst. The blastocyst is constituted by a specialized compartment called the inner cell mass (ICM), which is a group of approximately 30 cells. These human embryonic stem cell colonies are reported to be pluripotent in that they can differentiate into hundreds of others cell types in the adult body. (Fig 1) But for obtaining these stem cells the embryo has to be destroyed in the lab which brings in legal and ethical constraints.

2. Cord blood is another rich source of stem cells. 150cc of cord blood is collected under strict aseptic precautions and stored in the cord blood bank. This can be stored for 21 years and can be used for 120 diseases for the same child in the future.

3. Mesenchymal stem cells: The majority of craniofacial structures are derived from mesenchymal cells (MCs). During development, mesenchymal cells originating from the neural crest are known to migrate, differentiate, and subsequently participate in the morphogenesis of virtually all craniofacial structures, such as cartilage, bone, ligaments, cranial sutures, musculature, tendons, the periodontium, and the teeth.[2] Once migrated, MCs work synergistically with mesodermal cells in the morphogenesis of craniofacial structures. Both mesenchymal cells and mesodermal cells are derivatives of embryonic stem cells, a few hundred cells of the inner cell mass of the blastocyst. Mesenchymal cells undergo asymmetric division, with one offspring cell differentiating toward an end-stage cell, while the other replicates into an offspring mesenchymal cell. Residual offspring of mesenchymal cells, upon the completion of morphogenesis, continue to reside in various craniofacial tissues, and retain their status as stem cells. After birth, mesenchymal cells are called 'mesenchymal stem cells' (MSCs). In the adult, MSCs maintain physiologically necessary tissue turnover and, upon injury or disease, differentiate to launch tissue regeneration. Mesenchymal stem cells (MSC) are characterized by their capacity of differentiating into multiple types of cells derived from mesenchymal tissues such as chondrocytes, osteoblasts, adipocytes and myoblasts. Criteria for undifferentiated mesenchymal stem cells are that cells must be negative for hematopoietic progenitor cell markers such as CD14 (monocyte/macrophage), CD45 (common leukocyte antigen) and CD34 (hematopoietic stem/progenitor cells/ endothelium), plus express indicative markers of mesenchymal stem cells, including CD105, CD166, CD29, CD44 and STRO-1.[3] Bone marrow stromal system of postnatal organisms is an important source of mesenchymal stem cells. Friedesntein et al. (1987) were the first to recognize that bone marrow stromal system contains an adherent, clonogenic, self-renewing and fibroblast-like population cells (colony forming unit-fibroblastic, CFU-F) denominated bone marrow stromal stem cells (BMSSCs). Recently, mesenchymal stem cell populations derived from dental pulp (DPSCs), exfoliated human deciduous teeth (SHED), and adult periodontal ligament (PDLSCs) have been isolated and identified by their ability to generate clonogenic adherent cell clusters such as bone marrow stromal stem cells. Cloning experiments showed that DPSC, SHED, and PDLSC have a frequency of colony forming cells

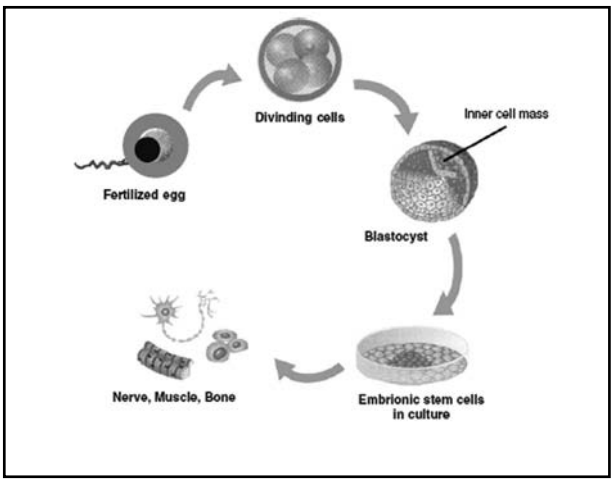

Fig 1. Schematic illustrations showing that stem cells derived from blastocyst stage of human embryos have been shown to differentiate into several cell types

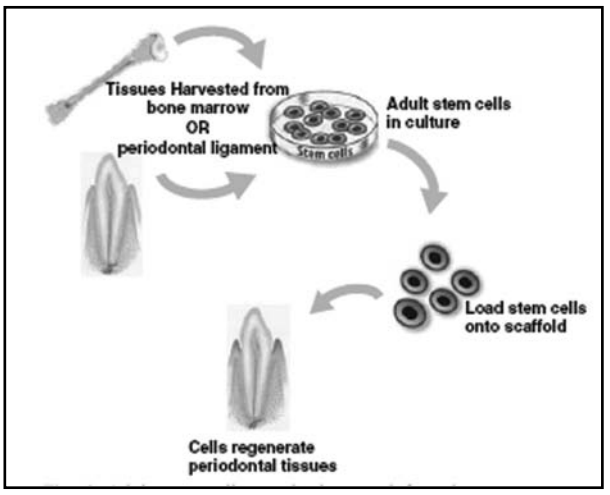

Fig 2. Adult stem cells can be harvested from bone marrow or periodontal ligament tissues and expanded in the laboratory. When loaded in appropriated scaffolds and transplanted in periodontal defects, stem cells have the potential to regenerate periodontal supporting tissues

significantly higher than that of the bone marrow.[4] Besides, proliferation studies demonstrated that multi-colony-derived DPSC, SHED and PDLSC cell cultures exhibited higher rates of proliferation, approximately 30%, 50%, and 30%, respectively, when compared to BMSSCs.[4]

Periodontal Ligament Stem Cells (PDLSCs): The concept that stem cells may reside in the periodontal tissues was first proposed almost 20 years ago by Melcher, who queried whether the three cell populations of the periodontium (cementoblasts, alveolar bone cells and periodontal ligament fibroblasts) were ultimately derived from a single population of ancestral cells or stem cells.[5] The putative presence of stem cells within the periodontal ligament has since been repeatedly referred to in the literature. However, little direct evidence has been provided to support this concept. The most compelling evidence that these cells are present within the periodontal tissues has been provided by the in vivo and histological studies of McCulloch and coworkers.[6] Since periodontal regeneration is essentially a re-enactment of the development process including morphogenesis, cyto differentiation, extracellular matrix production and mineralization, such processes support our concept that some mesenchymal stem cells remain within the periodontal ligament and are responsible for tissue homeostasis, serving as a source of renewable progenitor cells generating cementoblasts, osteoblasts and fibroblasts throughout adult life. In the event of injury to the periodontium these mesenchymal stem cells could be activated towards terminal differentiation and tissue repair or regeneration. SEO et at (2004) were the first group that isolated PDLSCs from normal impacted third molars.[7] Ex-vivo expanded PDLSCs formed mineralized nodules with the presence of calcium in the extracellular matrix and expressed an array of cementoblastic/osteoblastic markers, including alkaline phosphatase, MEPE (matrix extracellular phosphaglycoprotein), bone sialoprotein, osteocalcin, and TGFâ receptor type I. When ex-vivo expanded PDLSCs were transplanted into immunocompromised mice with the hydroxyapatite/tricalcium phosphate carrier particles, a typical cementum/PDL-like structure was generated, in which a thin layer of cementum-like tissues formed on the surface of the carrier, along with condensed collagen fibers containing sparse cells that resembled PDL structures. These PDL-like tissues were positive for anti-type I collagen antibody staining and were able to connect with newly formed cementum-like structures that mimicked physiological attachment of Sharpey's fiber. These results infer that PDLSCs might contain a subpopulation of cells capable of differentiating into cementoblasts/cementocytes and collagen-forming cells in vivo. To assess whether PDLSCs were able to contribute to periodontal tissue repair, SEO et al. transplanted these cells into surgically created defects at the periodontal area of mandibular molars in immunocompromised rats. Transplanted human PDLSCs integrated into the PDL and attached to both the alveolar bone and cementum surfaces. These findings imply a potential functional role of human PDLSCs for periodontal regeneration (Fig. 2)

Dental Pulp Stem Cells: Although the regenerative capacity of the human dentin/pulp complex is not well-understood, it is known that, upon injury, reparative dentin is formed as a protective barrier for the pulp. Accordingly, one might anticipate that dental pulp contains the dentinogenic progenitors that are responsible for dentin repair. Studies by GRONTHOS et al.[8] demonstrated that human DPSC cultures are

negative for odontoblastic-specific markers, such as dentin sialophosphoprotein (DSPP) and dentin sialoprotein (DSP), suggesting an undifferentiated phenotype of these cells. When 12 single-colony-derived DPSCs strains were transplanted with hydroxiapatite/ tricalcium phosphate (HA/TCP) particles subcutaneously into immunocompromised mice, twothirds of the single-colonies developed a abundant typical dentin/pulp-like complex consisting of a layer of odontoblasticlike cells, aligned around mineralized dentin, while only a limited amount of dentin was detected in the remaining one third. These results imply that single-colony-derived DPSC strains differ from each other with respect to their rate of odontogenesis[8]. However, independent of the density formed, all DPSCs transplants were capable of expressing DSPP identified by immunohistological analysis, indicating that this population of cells might respond to specific environmental signals and differentiate into cells with specific phenotype, in this case, the odontoblasts. In vitro analysis showed that DPSCs cultured with an adipogenic-inductive culture medium, were capable of differentiating into adipocytes identified by both the formation of Oil red O-positive lipid clusters and the increase in the expression of two adipocyte-specific transcripts - PPARy2 and lipoprotein lipase. Furthermore, DPSCs were found to express markers of neural precursors (nestin) and glial cells (GFAP), suggesting that DPSCs are similar to other stem cell populations, such as BMSSCs, because they are capable to give rise to diverse cells phenotypes.

Stem Cells from Human Exfoliated Deciduous Teeth (SHED): The exfoliated deciduous tooth houses living pulp remnants consisting of connective tissue, blood vessels, and odontoblasts. Miura et al., found that from 12 to 20 cells from each exfoliated incisor formed adherent colony clusters with extensive proliferative capacity).[9] Ex vivo-expanded SHED expressed STRO-1 and CD146 (MUC18), two early cell-surface markers for bone-marrow-derived MSCs. In addition, SHED expressed a variety of osteoblast/odontoblastic markers, including Runx2, alkaline phosphatase (ALP), matrix extracellular phosphoglycoprotein (MEPE), bone sialoprotein (BSP), and DSPP. After implantation into immunocompromised mice, with hydroxyapatite/ tricalcium phosphate (HA/TCP) as a carrier, SHED differentiated into odontoblast-like cells that formed small dentin-like structures. These results suggest that SHEDs are distinctive from DPSCs with respect to odontogenic differentiation and osteogenic induction.

Precursors cells (PCs) isolated from human dental follicle: Recently, precursors cells (PCs) isolated from human dental follicle of wisdom teeth were characterized by Morsczeck et al. These cells were able to create in vitro a structure similar to a periodontal membrane composed of fibroblast phenotype cells and calcified structures, full of alkaline phosphatase and bone sialoprotein. PCs transplanted into immuno-compromised mice can generate a structure lining the surfaces of the hydroxyapatite particles, consisting of fibrous and rigid connective tissue.

Besides, these cells can also express human-specific transcripts concerning bone sialoprotein, osteocalcin and type I collagen. However, these authors found no sign of cementum or bone formation in histological sections of PC-transplants.[10]

Conclusion and Challenges

The relationship between bone marrow MSCs and the newly identified stem cells from various dental derived tissues needs to be defined. In many ways, the newly characterized dental derived stem cells resemble bone marrow MSCs, especially in terms of their differentiation capacities. Whether dental-derived MSCs more effectively regenerate craniofacial structures than do appendicular MSCs needs to be explored, Also whether dental-derived MSCs are capable of healing non-craniofacial defects more effectively than are bone marrow MSCs also warrants investigation.

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Enterococcus faecalis

*** Roopa Prasannan, ** Rajesh Pillai, *** Ganesh C.**

Abstract

Enterococci are normal human commensal adapted to the nutrient-enriched, oxygen depleted, ecologically complex environments of the oral cavity, gastrointestinal tract, and vaginal vault. Enterococcus faecalis is the most commonly implicated microorganism in asymptomatic persistent root canal infections. The rapid emergence of antimicrobial resistance among enterococci makes it difficult to treat the chronic infections. This review attempts to evaluate materials and techniques in dealing with]Enterococcus faecalis.

The name "enterocoque" was first used by Thiercelin in a paper from France published in 1899; the name was proposed to emphasize the intestinal origin of this organism. Enterococcus faecalis is a non spore-forming, fermentative, facultative anaerobic, Gram-positive coccus. Enterococcus faecalis cells are ovoid and 0.5 to 1 μm in diameter. They occur singly, in pairs, or in short chains, and are frequently elongated in the direction of the chain. Most strains are non hemolytic and non motile. Surface colonies on blood agar are circular and smooth (Fig-1).[2] In 1930's Lancefield serologically classified Enterococci as group D Streptococci. In 1937, Sherman proposed a classification scheme, in which he recommended that the term 'enterococcus' should be used specifically for streptococci that grow at both 10ºC and 45ºC, at pH 9.6 and in 6.5% NaCl, survive at 60ºC for 30 minutes and have ability to split esculin.

Survival and Virulence Factors

E. faecalis possesses certain virulence factors including lytic enzymes, cytolysin, aggregation substance, pheromones, and lipoteichoic acid. It has been shown to adhere to host cells, express proteins that allow it to compete with other bacterial cells, and alter host responses. E. faecalis is able to suppress the action of lymphocytes, potentially contributing to endodontic failure. E.faecalis is not limited to its possession of various virulence factors, it is also able to share these virulence traits among species, further contributing to its survival and ability to cause disease.[3.]

Because E. faecalis is less dependent upon virulence factors, it relies more upon its ability to survive and persist as a pathogen in the pulp space of teeth.

E. faecalis overcomes the challenges of survival within the pulp space system in several ways. It has been shown to exhibit wide spread genetic polymorphism. It possesses serine protease, gelatinase, and collagen-binding protein (Ace), which help it to bind to dentin. It is small enough to proficiently invade and live within dentinal tubules. It has the capacity to endure prolonged periods of starvation until an adequate nutritional supply becomes available. Once available, the starved cells are able to recover by utilizing serum as a nutritional source. Serum, which originates from alveolar bone and the periodontal ligament, also helps E.faecalis bind to type I collagen. E. faecalis in dentinal tubules has been shown to resist intracanal dressings of calcium hydroxide for over 10 days. [4] It is also able to form a biofilm that help it to resist destruction by enabling the bacteria to become 1000 times more resistant to phagocytosis, antibodies, antimicrobials than non biofilm producing organisms.

Calcium hydroxide, a commonly used intracanal medicament, has been shown to be ineffective in killing E. faecalis on its own, especially when a high pH is not maintained. The following reasons have been proposed to explain the ability of E. faecalis is able to survive intracanal treatment with calcium hydroxide[5]

(a) E. faecalis passively maintains pH homeostasis. This occurs as a result of ions penetrating the cell membrane as well as the buffering capacity of intracellular cytoplasm

(b) It has a proton pump that provides an additional means of maintaining pH homeostasis. This is accomplished by "pumping" protons in to the cell to lower the internal pH

(c) At a pH of 11.5 or greater, E. faecalis is unable to survive. However, as a result of the buffering capacity of dentin, it is very unlikely that a pH of 11.5 can be maintained in the dentinal tubules with current calcium hydroxide utilization techniques

Survival and virulence factors of E. faecalis

- Endures prolonged periods of nutritional deprivation
- Binds to dentin and proficiently invades dentinal tubules

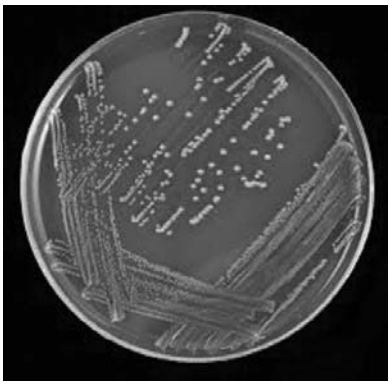

Fig.1. Enterococcus faecalis on a blood agar plate

Fig 2. Sodium hypochlorite.

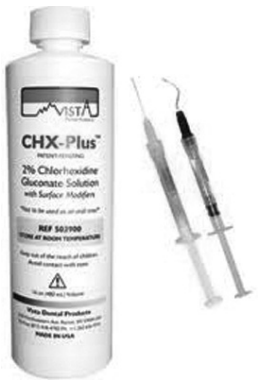

Fig 3. Chlorhexidine

- Alters host responses
- Suppresses the action of lymphocytes
- Possesses lytic enzymes, cytolysin, aggregation substance, pheromones, and lipoteichoic acid
- Utilizes serum as a nutritional source
- Resists intracanal medicaments like calcium hydroxide

-Maintains pH homeostasis

-Properties of dentin negate the effect of calcium hydroxide

Competes with other cells

Chair-side monitors

Monitoring chair-side bacterial activity provides advantage for the clinician & beneficial for the overall treatment outcome.

1**. Polymerase Chain Reaction(PCR)** is faster, more sensitive & accurate than culturing methods. PCR-based detection methods enable rapid identification of both cultivable and noncultivable microbial species with high specificity and sensitivity.[6] Real-time quantitative PCR (qPCR) and reverse transcription PCR are sensitive than traditional cultivation in detecting and quantifying E. faecalis in endodontic infections.

Disadvantages-

a. Detect only target microorganisms

b. Difficulty in microorganisms with thick wall.

c. Identify microorganisms qualitatively not quantitatively

2. **Optical spectroscopy** detects chair side presence or absence of E. faecalis. Optical spectroscopy in conjunction with specific enzyme synthetic chromogenic substrate-based medium allows the early detection of E. faecalis activity quantitatively and qualitatively, without the need for additional laboratory based culturing and plating for cell counting.[7]

Treatment considerations for eradication of e. Faecalis

The long cherished goal of endodontic treatment has been to eliminate infectious agents or substantially reduce the microbial load from the root canal.

Pre-treatment steps

Pre-rinsing the oral cavity with chlorhexidine before acess opening. Application of rubber dam is mandatory. The tooth & the rubber dam should be disinfected with 2% chlorhexidine & 2.5% sodium hypochlorite.

Cleaning & shaping

Current concepts focus on preparing the apical portion of the root canal to a larger instrument size which facilitate removal of microorganisms, which otherwise will not be accessible by small Master Apical File(MAF's). Larger preparations facilitate removal of the innermost pulpal dentin which in turn removes intratubular dentin to allow antimicrobials to penetrate more effectively.[8] Apical patency of the foramen must be checked to allow irrigants to circulate & vent out of the canal. In re-treatment cases, use of chloroform solvent & apical enlargement two sizes larger than original MAF showed significant reduction in cultivable microorganism

Root canal irrigants

1. Sodium hypochlorite.

Sodium hypochlorite is an effective irrigant for all presentations of E. faecalis including its existence as biofilms. 0.5 % to full strength sodium hypochlorite if used in adequate amounts and exchanged regularly has the capability to destroy E. faecalis. Presence of increased amount of organic material increased resistance to medicaments at different physiological growth stages of E. faecalis. Organisms in stationary phase were found to be more resistant to medicaments than those in the growing phase. Cells in starvation phase exhibited maximum resistance to medicaments and root canal irrigants. Starved cells survived maximum after challenge with chlorhexidine, sodium hypochlorite and calcium hydroxide.[9]

2.Chlorhexidine (Fig-3)

Chlorhexidine has been shown to be a potent broad

Fig 4. MTAD

Fig 7. EndoActivator

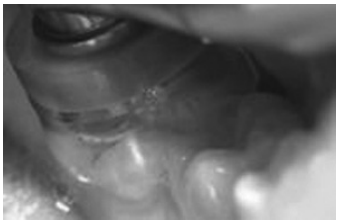

Fig 8. Healozone

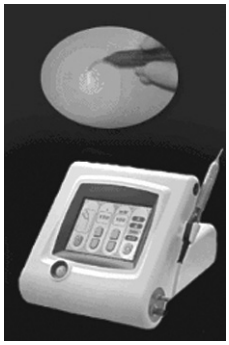

Fig 5. PhotoActivated Disinfection

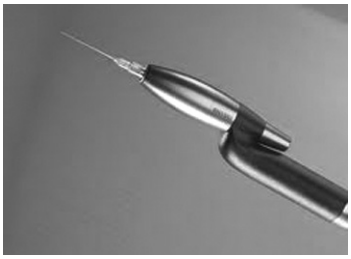

Fig 6. Rinsendo device

spectrum antimicrobial that is effective against Gram +ve & Gram –ve organisms.[12] Both 2% gel or irrigant forms are effective at reducing or completely eliminating E. faecalis from canal space and deep into dentinal tubules upto a depth of 100 ìm with contact time of 15 secs.

3.MTAD

MTAD is a formulation of tetracycline isomer (doxycycline), Tween-80 (detergent), and citric acid. Its effectiveness is attributed to its anticollagenase activity, low pH & ability to be gradually released over time.[10] It is highly effective against E. faecalis, superior to NaOCl and beneficial for re-treatment. Doxycycline & Citric acid exhibits antimicrobial activity and dentine conditioning properties

4. Combinations

Calcium hydroxide and camphorated paramonochlorophenol can completely eliminate E. faecalis. Metapex [Calcium hydroxide & 38% iodoform] provides effective disinfection than when calcium hydroxide used alone. 2% chlorhexidine & calcium hydroxide achieve pH of 12.8 and can completely eliminate E. faecalis. However, chlorhexidine alone is more superior to this combination. Tween-80 itself has limited antibacterial properties and is known to enhance antibacterial properties of other substances. However, it may neutralize antibacterial properties of chlorhexidine & Povidone Iodine.

5. MTAD and chlorhexidine digluconate with / without cetrimide.

MTAD contains Tween 80 which facilitates penetration of MTAD into bacterial cell membrane. Synergistic action of chlorhexidine & cetrixidine killed E. faecalis effectively & more immediately after contact than MTAD and chlorhexidine. Dentin delayed antibacterial property of chlorhexidine in presence of BSA (Bovine Serum Albumin) Chlorhexidine & Cetrimide killed E. faecalis rapidly than chlorhexidine alone and therefore synergistic action was observed.[11] Tetracycline shows bacteriostatic effect by inhibition of cell wall synthesis.

Newer irrigation techniques

Photoactivated disinfection (PAD)

PAD is a unique combination of a photosensitizer solution and low-power diode laser light of wavelength 635nm.

The photosensitizer, which is mostly coloured, adheres to or gets absorbed by microbial cells. The low-power laser will hit the marked targets and inactivate those microbial invaders. Low power (diode) laser energy in itself is, again, not particularly lethal to bacteria but is useful for photochemical activation of oxygen-releasing dyes. Singlet oxygen, a protoplasmic poison released from dyes, causes lethal membrane, organelle and DNA damage to microorganisms. Laser light activates the photosensitizer (Tolonium chloride) and creates a cascade of energy transfer and variable chemical reactions in which singlet oxygen and free radicals play an important role.[13] Thus, the results of this laser activation are cracks in the cell wall (implosion of cells), crucial protein degradement, organelle demolishment, inactivation of their virulence factors (eg, toxins) and even DNA damage.

Advantages

1. Its quite impossible for the organism to create resistance against it.
2. PAD needs a maximum of 150 seconds contact time.
3. PAD works precisely: only at the infected site, not elsewhere in the human body.

Rins endo device

Has a compressed air-driven dynamic root canal

irrigation system for vigorous controlled flushing. It uses an alternating flushing/suctioning action to actively flush the root canal system. However, the needle insertion must be well controlled because it is an "active" rather than passive irrigation system.[14]

Electrochemically activated water

Sterilox is a device that attempts to use Electrochemical activation (ECA) as a tool for irrigation. Based on the process of transferring liquids into a metastable state via an electrochemical unipolar (anode or cathode) action through the use of an element/ reactor ('Flow-through Electrolytic Module' or FEM). The FEM consists of an anode, a solid titanium cylinder with a special coating that fits coaxially inside the cathode, a hollow cylinder also made from titanium with another special coating[13.]

EndoActivator

The EndoActivator is a soon to be released device designed by Cliff Ruddle. This consists of a small battery operated cordless handpiece which delivers sonic energy onto nylon tips which can be attached to the handpiece. The advantage of attaching Nylon tips would make the device more flexible and less prone for breakage when compared to ultrasonic files. This device promises to produce even more acoustic streaming than conventional ultrasonic devices[13.]

Ozonated water irrigation

Ozone is an effective, easy, cheap, and fast treatment to help disinfect root canals. Ozone is much stronger than chlorine. As ozone is the most powerful antimicrobial and oxidant we can use in endodontics, and as aqueous ozone revealed the highest level of biocompatibility compared with commonly used antiseptics. Healozone (fig-8) is a device used to deliver ozone in infected pulp space.[14]

Lasers

Er,Cr:YSGG laser (erbium, chromium:yttrium-scandium-gallium-garnet) in conjunction with radial-firing tips, is a suitable tool for the elimination of bacteria in pulp space and for the removal of smear layer. Specifically, erbium, chromium:yttrium-scandium-gallium-garnet (Er,Cr:YSGG) laser is emitted at a wavelength of 2.79 ìm and has energy interaction with water at the tissue interface. Biolase combines laser light and water, advantage of fastcutting without heat, vibration or pressure and procedure completed in 2-3 minutes[15]

Conclusion

Our challenge as endodontists is to implement methods to effectively eliminate E.faecalis during and after root canal treatment. Currently use of good aseptic techniques, increased apical preparation sizes, and inclusion of full strength sodium hypochlorite and 2% chlorhexidine irrigants are the most effective methods to eliminate E.faecalis. Recent advances have helped us better understand E.faecalis and the mechanism that enable it to cause persistent endodontic infections. In the changing face of dental care, continued research on E.faecalis and its elimination from the dental apparatus may well define the future of retreatment in endodontics

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Efficacy of bioglass (HABG) grafting over non grafting on mandibular third molar extraction sites- A comparative study

*** Sajesh S., ** Manjunath Rai**

Abstract

Objectives: the purpose of this study was 1. To assess and evaluate the effectiveness of Chithra hydroxyapatite bioglass composite granules (Chithra (HABG)) as a graft material in the healing of extraction sockets following third molar removal. 2. To analyze the effect of the material with regard to periodontal pocket depth and inflammation distal to second molar. 3. To investigate the merit of the material with respect to its impact on the incidence of post operative complications such as pain or dry socket and also to study the amount of osseous fill.

Methods: In this study a total of 25 patients with bilateral mandibular 3rd molar impactions were selected, age range at an averaging 18-30 years. Impacted tooth on the right side was denoted as site –A on which grafting of Chithra hydroxyapatite bioglass composite granules (Chithra HABG) was performed following removal of that tooth, where as the left side was chosen as site B and it was allowed to heal without interposition of any graft material following surgery. All patients were evaluated on the 3rd and 7th post operative day, they were evaluated for the presence of any inflammation, periodontal pockets distal to mandibular second molars, pain; dry sockets or any other pathologies respectively. Radiographic assessment was made at intervals of 3 months, 6 months and 9 months using panoramic study to evaluate the amount of osseous fill at both the grafted and non grafted sites.

Results: Periodontal pocket distal to second molar and inflammation was significantly less in the grafted site when compared to that of the non grafted site. Incidence of postoperative pain was less in grafted site when compared to the non grafted site. There was no dry socket at both grafted as well as on the non grafted site. Radiographic evaluation showed good osseous fill in both grafted as well as on the non grafted site. The tests used in this study were Kruskal-Wallis test, Mann Whitney u test, Wilcoxon signed-rank sum test.

Conclusion: This study shows the treatment of extraction site with Chithra (HABG) significantly alter the periodontal probing depth, inflammation, less incidence of pain and also shows good osseous fill distal to second molar.

Reconstruction of complex osseous defects in craniofacial region is challenging to the modern surgeon. An osseous defect in the craniofacial region may result from minor surgeries trauma infection congenital anomalies or due to oncological ablative surgeries. Development of predictable methods to reconstruct and methods to enhance bone regeneration is a priority for dental and medical specialties.

Historical records from implantation of natural minerals and gem-stones goes far back to the period 600-800 A.D, followed by ivory, inert metals, and bone products.[1] Bone grafting is used by many surgical specialists. Various materials are attempted by clinicians to replace the defects in orofacial region. Most of these bone replacement materials act as defect fillers or scaffolds and there by promotes regeneration. Autogenous bone graft has been used more frequently as it can be harvested easily and gives the best possible functional and cosmetic results. Various other materials like xenografts and allografts gave been used to overcome the disadvantages of auto grafts, such as donor site morbidity, limited availability,[3] high incidence of resorption.

Allografts are becoming a more accepted form of bone grafts. The majority of large allografts assumes a near-normal / function in individuals who lack certain areas of the body that have been resected for oncologic problems or for other reasons. It is frequently possible for these areas to be replaced, and the patient can resume normal function.[2] The problems with allograft include premature resorption, delayed resorption, highly variable inductive properties and potential for disease transmission. Numerous materials have been invented and used in clinical practice which includes metals, polymers and ceramics.

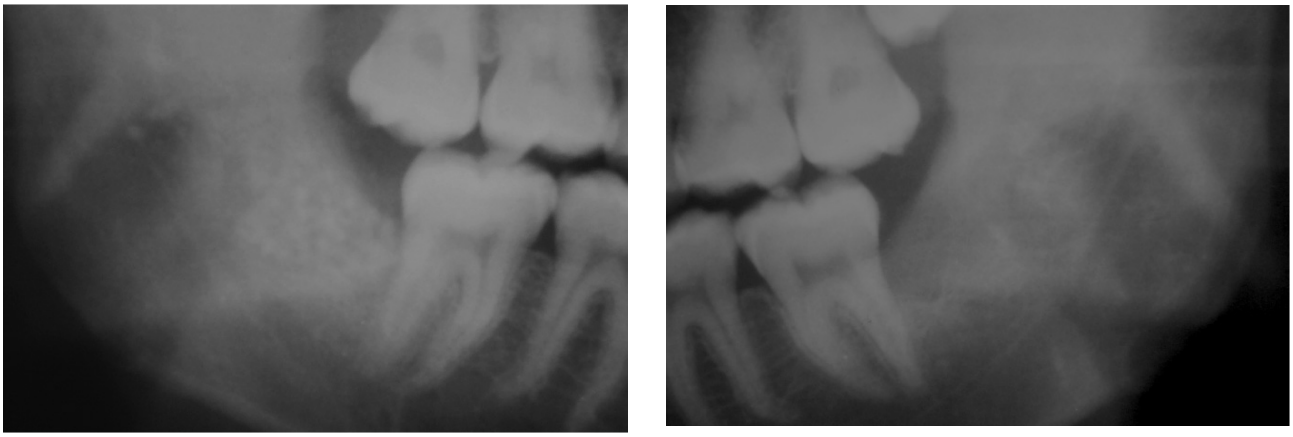


Fig I:
Post operative 3 months with graft Post operative 3 months with out graft

The ideal bone replacement material should be chemically and biologically inert, surgically convenient, dimensionally stable, non carcinogenic, consistently induce bone formation, has an unlimited supply and easy to use.[3] Recently more emphasis is given on search bone replacement material which enhances bone regeneration.

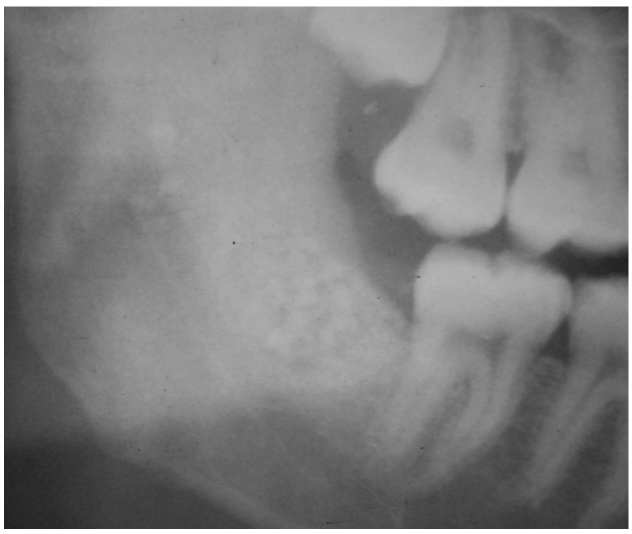
Bioactive bone grafting particulate, the material is the particulate form of Bioglass, which was first developed by Dr. Larry Hench in the 1970's. The basis of the bonding property of bioactive glasses is their chemical reactivity in body fluids. Upon contact with body fluid, there is an immediate exchange of ions, which results in a physiochemical bond between bioactive glass, soft tissue and bone. The ion exchange creates an environment resulting in the formation of a hydroxy Carbonate apatite layer (HCA), a biological apatite identical to the mineral phase of bone which allows for more rapid repair and regeneration of bone than other synthetic grafting materials. Three general process leaching, dissolution and precipitation occur when a bioactive glass is exposed to body fluids. The leaching reaction occurs via ion exchange mechanism. Sodium is leached from the glass and replaced with protons from the solution. Concurrent with the leaching reaction, dissolution of the glass silica network occur. As silicic acid is released into solution, silanol groups form a hydrated layer at the glass surface. The silanol groups undergo a rearrangement via a poly condensation reaction to produce silica gel. The silica rich gel has a large surface area and a negative surface charge. This gel serves as a nucleation site to the formation of a calcium phosphate layer (CAP). The CAP phase that accumulates at the surface of the silica gel is initially amorphous, but subsequently crystallizes to hydroxycarbonate apatite structure by incorporating carbonate anions from the solution within the amorphous CAP phase. Organic species in the local environment such as collagen, chondrotin sulphate and glycosaminoglycans are incorporated into this bioactively forming layer. Osteoblasts are attracted to the hydroxy carbonate apatite and release organic constituents, followed by mineralization. The end result is a strong, bonded interface consisting of a series of layers: glass-silica gel- hydroxycarbonate apatite-bone. The Bioglass initiated HCA layer is biologically equivalent to the mineral phase of human bone, and is therefore recognized by the body as being something natural, not synthetic. This is followed by collagen deposition and cellular differentiation resulting in chemical bonding and enhanced healing of the defect. This bonding is theorized to prevent the fibrous encapsulation from occurring at the material surface. Studies have shown greater new cementum and alveolar bone formation with bioglass than other materials.[4] bioactive glass is a bioactive material that can be used in granular form to fill bone defects,[10] and is well tolerated by human tissues[13.]

It has the ability to bond to bone tissue and in addition, it enhances bone tissue growth due to its osteoconductive properties.

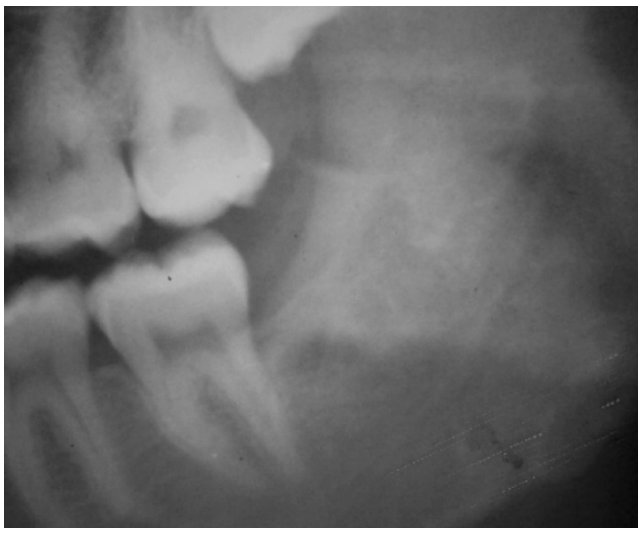
Bioactive glass ceramics have found a wide range of application in other fields of dentistry and medicine. Bioactive glasses have also been used in the management of orbital floor fractures,[5] frontal sinus obliteration, sinus floor elevation[6] and various other osseous reconstructive procedures. They find use as liners for prosthetic applications. Bioactive glasses have also been used in bone cements and as fillers in polymer composites.

The Chithra hydroxyapatite bioglass composite granules (Chithra HABG) used in this study was developed by the Biomedical Technology Wing of Sree Chithra Thirunal Institute of Medical Sciences and Technology (SCTIMST), Thiruvananthapuram.

This material was developed as a part of their research on the development of bioceramics for hard tissue applications. These granules are made up of a combination of bioactive glass and hydroxyapatite, aimed at achieving better clinical results. It is a new



Post operative 6 months with graft



Post operative 6 months with out graft

generation composite bioactive material containing Si, Ca and P made through a non-conventional processing method - 'the sol – gel process'. The particle size range is 1 – 2mm.

The material after passing the screening tests of haemolysis and cytotoxicity had been subjected to toxicological studies. All the mandatory tests necessary have been performed to qualify the materials for implantation studies. After evaluation of the satisfactory results of pre- clinical trials, the ethical committee of Sree Chithra Thirunal Institute of Medical Sciences and Technology (SCTIMST), Thiruvananthapuram has approved the use of these materials in human clinical trials. This material has been used successfully in the treatment of periodontal infrabony defects.

The purpose of this study is

a. To compare the bone regenerative capacity of Chitra Hydroxyapatite bioactive glass composite to that of a non grafted site by radiographic assessment for a period of 9 months.

b. Clinical assessment of healing.

Patients and methods

Selection of the Patient: Inclusion criteria: Unremarkable health history, No allergy to the drug used in the study, Age group 18-30 yrs. Exclusion criteria: Patients Who smoke, Patients having acute infection,

Clinical parameters: A total of 25 patients with bilateral mandibular 3rd molar impactions were selected for the study, with an age range of 18- 30 years. The nature of the study was explained to the patient and informed consent was taken before starting the procedure. Pre operative clinical evaluation was done to rule out acute inflammation, gingival condition and oral hygiene status of the patient. Pre operative radiographs were taken to access the nature of impaction.

After the surgical removal of impacted tooth the experimental site A – right side was grafted with Chithra hydroxyapatite bioglass composite granules (Chithra HABG), where as the surgical site B – left side, received no graft. Primary closure of the wound was done. All patients were evaluated for pain on 3rd and 7th day post operatively. Patients were evaluated for any inflammation, periodontal pockets distal to mandibular second molars, pain; dry sockets post operatively.

Post operative radiographs (Orthopantomogram) were taken on 3 months, 6 months and 9 months interval to visually evaluate the bone formation in both grafted and non grafted sites.

Procedure: A standard pre – sterilized minor oral surgical kit was used for all cases.

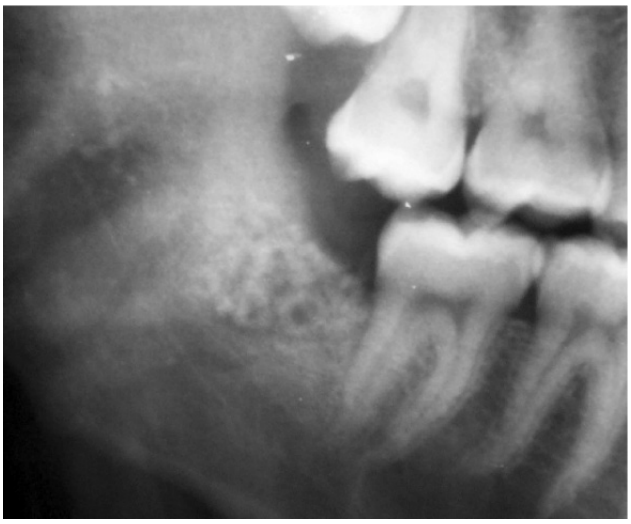
Anesthesia: Prior to surgical procedure a mouth rinse of povidone iodine with water in dilution of 1:5 was given to the patient. The patients were anesthetized with 2 percent lignocaine hydrochloride with adrenaline concentration of 1:100000 by giving inferior alveolar nerve block,[23] anesthetizing inferior alveolar nerve, lingual nerve and long buccal nerves.

Incision: A standard Terence ward's incision[24] was placed in all cases and vertical incisions were also placed. Utmost care was taken to minimize the trauma to the soft tissues during reflection of the flap.

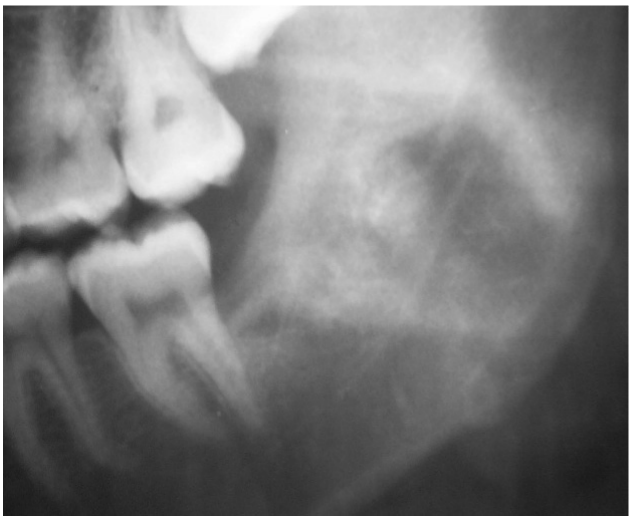
Bone removal: Bone removal was done by buccal guttering technique and was performed using rotary instruments with proper cooling[25]. Maximum care was taken to preserve the alveolar bone on the buccal side. Wherever there was locking of the tooth sectioning of the tooth was performed with rotary instruments.

Toilet of the wound and hemostasis: Following delivery of the tooth a thorough toilet of the surgical wound was done and hemostasis was achieved prior to placement of the graft material. Any remaining dental follicle was curetted from the surgical site.[3]

Placement of the hydroxy apatite bioglass granules: The materials were supplied in a sterilized



Post operative 9 months with graft



Post operative 9 months with out graft

plastic vials. The Chithra hydroxy apatite bioglass granules were then delivered into a sterile dappendish, where the granules were mixed with few drops of saline[19] which will facilitate easy delivery and adaptation to the socket and the material was gently spread and condensed into socket. Over filling of the socket and spillage into soft tissue was avoided.

Closure of wound: A perfect soft tissue closure was achieved with 3-0 braided black silk sutures.[25] Pressure pack was given with sterile gauze.[24]

Post operative instructions and medications: All patients were given following post operative instructions and medications.

Follow up: The patients were recalled on the first, third, fifth and the seventh post operative days to asses the immediate post operative tissue response to surgery and placement of material. During the post operative reviews following aspects were reviewed.

Post operative assessment:

Assessment of pain: Visual analog scale (VAS)[26] was used for the assessment of post operative pain. The assessment was done on the 3rd post operative day and on the 7th post operative day.

Assessment of periodontal pockets distal to 2nd molars: Periodontal pockets distal to second molar was measured using Williams periodontal probe. Pocket depth was checked distal to 2nd molar tooth.[27] Pocket depths were measured at 3months, 6months and 9months intervals.

Assessment of inflammation: Inflammation was assessed using Modified Gingival Index (MGI)[28]at 3 months, 6 months, and 9 months intervals.

Assessment of dry socket: Any signs and symptoms of dry socket or infection or any other complications were checked.[3]

Radiological assessment: Radiological assessment was done using Orthopantomogram; Fig I, documentation of the osseous fill was done[19] at 3months, 6months and 9 months intervals. Visual evaluations of the radiographs were done and the bone formation at both grafted and non grafted sites were analyzed. The most common and the most frequently used method assessments of outcome is noninvasive radio graphic analysis. Unfortunately, whether complete vascularization has occurred cannot be determined through radiographic analysis; for such, other techniques are used.[2]

In this study clinical parameters like clinical attachment levels were not included because a custom stent was needed for evaluating such parameters. The majority of the patients included in this study were not willing for any other procedures including the stent preparation, so the usage of custom stent was not used as reference for clinical attachment levels and also for radiographic osseous fill.

Results

In Table 1 the result shows in the grafted site at 3 months 6 months and 9 months the mean values for the modified gingival index is 1.0000, 1.0000, 1.0000 respectively and at the non grafted site at 3months 6months and 9months is 1.4500, 1.0500, 1.0500 respectively. The p value for the grafted site is 1.00 which is non significant and the p value for the non grafted site is .001 which is very highly significant. This shows that there is no significant inflammation in the grafted site and mild amount of inflammation in the non grafted site.

Table II shows in the grafted site at 3months, 6months and 9months the mean probing depth is 2.8000, 2.2500, and 2.1000 respectively and at the nongrafted site at 3months, 6months and 9months the mean probing depth is 4.000, 3.2000, 2.8000 respectively. The p value for the grafted site is .001, which is very highly significant, and the p value for the non grafted

Table 1: *Evaluation at 3, 6 and 9 months - MGI*

Modified gingival index

GROUP		N	Mean	Std. Deviation	H	p
Graft	3 months	20	1.0000	.00000		
	6 months	20	1.0000	.00000		
	9 months	20	1.0000	.00000	.00	1.00
Non graft	3 months	20	1.4500	.51042		
	6 months	20	1.0500	.22361		
	9 months	20	1.0500	.22361	14.01	.001 vhs

a. H= Kruskal Wallis test

site is .005, which is highly significant. This shows that there is a significant reduction in pocket depth in grafted site comparing the non grafted site.

Table III shows in comparing the pain in grafted and non grafted site using visual analog scale it was seen, during the 3rd post operative day the mean value for pain is 17.0000 at the grafted site and 21.2500 in the non grafted site, the p value is .021 which is significant. Where as during the 7th post operative day the mean value for pain is 8.7500 at the grafted site and 10.2500 at the non grafted site, the p value is .081 which is non significant. This shows that there is reduction in pain during the 3rd post operative day in grafted site when comparing the non grafted site but during the 7th post operative day the reduction in pain comparing both sides is insignificant.

Discussion:

The mandibular third molar are the ones with the largest frequency of impaction necessitating surgical removal. The risk of non-intervention may lead to lower anterior imbrication, development of pathological conditions like infections due to the number of potential spaces around, and development of cysts and tumors. The management of osseous and soft tissue defect distal to second molars as a result of the surgical removal of impacted third molars can be a challenge and especially in older patients who are more likely to heal slowly, with reduced bone volumes.[3] However there have been no comparative studies so far to asses the effectiveness of bioactive glass in 3rd molar sites.[3]

Bioactive glass in addition to its osteoconductive properties, it also has an osteostimulatory effect and creates an environment that facilitates bone formation.[9] The osteoconduction is important in bone substitutes such as the filling of bone defects so granules may prove useful than blocks.[7] The new bone formed has histologic and biomechanical properties of surrounding bone as soon as 7 months of grafting. Bioglass particle resorb over time and are gradually replaced by bone.[21] Bioactive glass paste appears to possess a broad antimicrobial effect on microorganism of both supra and sub gingival plaque. Bioactive glass is considered as adjunct to conventional surgery because it increases the clinical attachment level, hard tissue fill and reduces bone probing depth[18, 17, 15] in the treatment of intrabony defects,[8,14,12] base, liner, treatment of hyper sensitive dentin[30] and as rootcanal medicament.[22] Resorbable bioactive glass activated the cells necessary for bone formation better than hydroxyapatite and suppressed the formation of osteoclasts for bone resorption. Resorbable bioactive glass and resorbable hydroxyapatite were found to be harmless to periodontium cells and lymphocytes. This material has also been shown to be effective in maintaining the alveolar ridge following tooth extraction.[8,16,11] Implants will survive for up to 3 years in sites grafted with bioactive glass.[20] Because of its biocompatibility, lack of disease transfer risks and ease of use, bioactive glass remains a viable choice as a regenerative material.[3] Bioactive glass is cohesive, remains in place even with adjacent suctioning, and aids in hemostasis.[19]

In this study it was seen the site grafted with Chithra HABG had less pain, (mean value 17.00), when compared to the non grafted site, (mean value 21.25), p=.021 which is significant during the 3rd post operative day. Even though pain during the 7th post operative day was less in both grafted(mean value 8.75) as well as in the non grafted site (mean value 10.25), the grafted site showed comparatively lesser pain, p=.081 which is non significant.

Assessments of periodontal pockets were done with Williams periodontal probe. The periodontal pockets were checked distal to the second molar during 3rd, 6th and 9th month post operatively. The periodontal pocket, defined as pathologically deepened gingival sulcus, is one of the most important clinical features of periodontal disease.[29]

Table II: *Evaluation at 3, 6 and 9 months*

Pocket depth

GROUP		N	Mean	Std. Deviation	H	p
Graft	3 months	20	2.8000	.69585		
	6 months	20	2.2500	.44426		
	9 months	20	2.1000	.30779	17.21	.001 vhs
Non graft	3 months	20	4.0000	1.16980		
	6 months	20	3.2000	1.28145		
	9 months	20	2.8000	.89443	10.51	.005 hs

a. H= Kruskal Wallis test

In this study it was seen that there is a significant reduction in pocket depth distal to second molar in the site grafted with Chithra HABG when compared to the non grafted site. At 3 months the mean pocket depth of grafted site was 2.80 and non grafted site was 4.00, and the p = .001, which is very highly significant. At 6 months the mean pocket depth of grafted site was 2.25 and non grafted site was 3.20 and the p=.01 which is highly significant. At 9 months the mean pocket depth of grafted site was 2.10 and non grafted site was 2.80 and the p=.001 which is very highly significant.

Inflammation was checked distal to second molar, in and around the surgical site during the 3rd, 6th and 9th month follow up visits using the modified gingival index (MGI). The MGI is perhaps the most widely used index in clinical trials of therapeutic agents. The gingival index is a method for assessing the severity and quantity of gingival inflammation.[28] In this study it was clearly seen that the site grafted with Chithra HABG showed significantly less inflammation during the follow up period when compared to the non grafted site. The incidence of inflammation was less in the grafted site (mean value 1.00) when compared to the non grafted site (mean value 1.45) and p=.001 which is very highly significant at 3 months post operatively. At 6months post operatively the mean value for inflammation at the grafted site was 1.00 when compared to the non grafted site 1.05, the p=.317 which is non significant. At 9 months post operatively the mean value for inflammation at the grafted site was 1.00 when compared to the non grafted site 1.05, the p=.317 which is non significant.

Any incidence of dry socket was checked post operatively during the immediate follow up visits. In this study it was seen that during the immediate follow up visits no patients reported with signs and symptoms of dry socket in both sites grafted with Chithra HABG as well as on the non grafted sites.

Radiological assessment was made by taking Orthopantomogram fig I, at 3 months, 6 months and 9 months intervals post operatively and the osseous fill was visually analyzed. In this study it was seen in the radiograph that both the site grafted with Chithra HABG as well as the non grafted site showed significant osseous fill in the extraction socket, maintaining the bone height distal to the second molar during the follow up.

Out of the 25 patients included in this study 20 patients came for the regular follow up visits. In 3 patients the graft was removed with in 2 weeks post operatively because in one patient there was paresthesia following the extraction of deep impaction. And in two patients they showed signs of pain and inflammation and the graft was removed, it was found that they were not following the post operative antibiotics and instructions properly. Follow up of two patients was not available during the correct intervals. Although there was mild wound gaping in few cases in both grafted site as well as in the nongrafted sites both sites healed uneventfully with very minimal loss of graft material.

Summary and Conclusion

Based on the conducted study the following conclusions are inferred

1. The clinical and radiological results of this study suggest that use of Chithra hydroxyapatite bioglass might be considered in those cases of deep impacted third molars where there is concern regarding bone height and periodontal status distal to the second molar, particularly in the older patient.

2. Since there is less incidence of pain and infection and no significant signs of inflammation and dry socket seen in this study, favour the using of Chithra hydroxy apatite bioglass composite granule for the treatment of cystic cavities, periodontal osseous defects or in extraction sockets for preservation of alveolar ridge dimensions. However a study including a large sample size might provide us with much more valuable information regarding the use of Chithra hydroxyapatite bioglass (ChithraHABG) for various defects.

Table III: *Comparison at 3rd and 7th day*

VAS

PERIOD	GROUP	N	Mean	Std. Deviation	Z
3rd Day	Graft	20	17.0000	5.47723	2.30100
	Non graft	20	21.2500	5.34962	p=.021 sig
7th day	Graft	20	8.7500	2.75060	1.74700
	Non graft	20	10.2500	2.55209	p=.081 ns

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Research

Evaluation of antimicrobial efficacy of Psidium guajava: against oral micro flora- an in vitro study.

***Vinod B. Mathew, **Jimly James K, ***Apoorva C**

Abstract

Context: Natural plant extracts and products contain many active antibacterial agents that are beneficial to prevent diseases. Psidium guajava is a plant commonly seen in tropical and subtropical regions all around the world and traditionally used for curing many ailments. Aim: A comparative evaluation of antimicrobial efficacy of aqueous extract of Psidium guajava and chlorhexidine gluconate against Streptococcus mutans and Enterococcus faecalis

Methodology: Ascending strengths of (0.2%, 5%, 10% and 50%) Psidium guajava crude leaf-extract and 0.2% of Chlorhexidine gluconate are tested for inhibition of Streptococcus mutans and Enterococcus faecalis bacterial cultures by agar plate diffusion method.. Statistical analysis: The results were tabulated and analysed statically with student's t test and paired student's t test ($p \leq 0.05$)

Results: All other concentrations had statistically significant difference in levels of inhibition. 10% Psidium guajava extract and 0.2% chlorhexidine gluconate showed similar zones of clearance of both organisms.

Conclusion: From this study it can be concluded that Psidium guajava extract has antibacterial properties against Streptococcus mutans and Enterococcus faecalis. Crude extract of Psidium guajava is not as effective as chlorhexidine when used at concentrations lower than 10% concentrations.

Introduction

The use of medicinal plants in curing illness is as old as civilization. *P guajava* (guava) belonging to the family Myrtaceae is one such plant acclaimed to exhibit anti-bacterial activity.[1] Decoction made from the leaves has been used for diarrhoea, sore throat, vomiting, for vertigo and inflamed gums.[2] The therapeutic activity of guava is attributed to the flavinoids in particular, Quercertin. Guava also has anti-oxidant property which is attributed to Polyphenols found in the leaves.[3] Neem, mango and guava leaves are used to clean the teeth every morning by villagers in South India.

The use of anti-caries agents like fluorides have decreased the incidence of caries but they alone cannot effect considerable change in the prevalence of the disease.[4] Several natural agents like neem, green tea, morinda leaves and mango leaves have been tested for their capacity to decrease the level of cariogenic bacteria.[5]

The purposes of endodontic treatment are to attain sterilization of the root canal system and obturate the canal space tightly to avoid microbial growth.[6,7] Enterococcus faecalis is commonly detected in asymptomatic, persistent endodontic infections. Its prevalence in such infections ranges from 24% to 77%. This finding can be explained by various survival and virulence factors possessed by E. faecalis, including its ability to compete with other microorganisms, invade dentinal tubules, and resist nutritional deprivation.[8,9] This study focuses on the evaluation of crude P guajava extract to inhibit the growth of Streptococcus mutans, the primary cariogenic organism and Enterococcus faecalis the primary organism associated with failed endodontic treatment.

Methodology

The study is an in-vitro design entailing a microbial culture under standard conditions. Ascending strengths of (0.2%, 5%, 10% and 50%) Psidium guajava crude leaf-extract and 0.2% of Chlorhexidine gluconate are tested for inhibition of Streptococcus mutans and Enterococcus faecalis bacterial cultures by agar plate diffusion method

Preparation of crude extract of Psidium guajava:

Hundred milligrams (100mg) of the dried powdered leaves of P. guajava was mixed in 100 ml of distilled water for 3 hours using the reflux method. These were respectively filtered using No.1 filter paper and concentrated in vacuum to obtain the aqueous extract of Psidium guajava (greenish-brown color).[10]

Streptococcus mutans MTCC 890 strain and Enterococcus faecalis ATCC 29212 strains were used as the test organisms. Agar well diffusion technique as

Table I: *Grouping of the medicaments for study.*

Group 1	Psidium guajava 50mg/100ml – 50%
Group 2	Psidium guajava 10mg/100ml –10%
Group 3	Psidium guajava 5mg/100ml – 5%
Group 4	Psidium guajava 0.2mg/100ml – 0.2%
Group 5	Chlorhexidine gluconate 0.2mg/100ml – 0.2%
Group 6	Distilled water (negative control)

described by Adeniyi et al. (1996)[10, 11] and Nwinyi et al (2008) [9] was used to determine the antibacterial activity of the medicaments. Ten sensitivity test plates with BHI agar were seeded with 0.1ml of an overnight culture of each bacterial isolate (Enterococcus. faecalis and Streptococcus species equivalent to 10^7–10^8 CFU/ml). The seeded plates were allowed to set and a glass pipette of four mm diameter was to be used to cut six uniform wells of eight mm depth on the agar. The wells were then filled with 0.3 ml of each medicament to be tested.

Psidium guajava at concentrations of 50%, 10%, 5% and 0.2% was tested against one group of chlorhexidine gluconate 0.2% and a control group with distilled water (Table 1). All the plates were incubated at 37°C for 24 hrs. The diameters of zones of clearance around the wells were measured with millimeter scale. The diameters of the wells were subtracted from it in order to measure the level of inhibition of the organisms by the medicaments.

Results

The results were tabulated and analysed statically with student's t test and paired student's t test ($p \leq 0.05$). The tested medicaments showed inhibition of growth of both Streptococcus mutans and Enterococcus faecalis at all concentrations. The comparative inhibitions of the two organisms were similar at each concentration (Table 2). 10% P guajava extract and 0.2% chlorhexidine gluconate showed similar zones of clearance of both organisms. All other concentrations had statistically significant difference in levels of inhibition (Table 3).

Table II: *Statistical analysis with students t test. (Response of test substances to the growth of Streptococcus .mutans and Enterococcus .faecalis.)*

	group	*N*	*Mean*	*Std. Deviation*	*Std. Error Mean*	*P value*
guava50	S.mutans	10	21.2000	1.68655	.53333	.476
	E.faecalis	10	21.8000	1.98886	.62893	
guava10	S.mutans	10	15.3000	1.70294	.53852	.613
	E.faecalis	10	15.7000	1.76698	.55877	
guava5	S.mutans	10	6.6000	1.42984	.45216	.500
	E.faecalis	10	7.0000	1.15470	.36515	
guava_0.2	S.mutans	10	.7000	.67495	.21344	.749
	E.faecalis	10	.6000	.69921	.22111	
chx_0.2	S.mutans	10	14.8000	1.68655	.53333	.699
	E.faecalis	10	15.1000	1.72884	.54671	

Table III: *Intergroup comparison with paired student's t test. (Details of bacterial inhibition using various test substances)*

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*	*T value*	*P value*
Pair 1	guava50	21.5000	20	1.82093	.40717	11.807	.000
	chx_0.2	14.9500	20	1.66938	.37329		
Pair 2	guava10	15.5000	20	1.70139	.38044	1.067	.299
	chx_0.2	14.9500	20	1.66938	.37329		
Pair 3	guava5	6.8000	20	1.28145	.28654	-16.696	.000
	chx_0.2	14.9500	20	1.66938	.37329		
Pair 4	guava_0.2	.6500	20	.67082	.15000	-34.790	.000
	chx_0.2	14.9500	20	1.66938	.37329		

Discussion

The guajava leaves, roots and fruit have been used traditionally in folk medicine for the treatment of diarrhea and dysentery.[12,13,14] Guajava are rich in flavinoids, in particular, quercetin. Much of guava's therapeutic activity is attributed to these flavinoids.[3, 15] The use of guajava extract in this study aimed to compare the efficiency of traditional folk remedies and conventional chemicals that are presently being used as antibacterial agents in dental treatment.

The methodology for this study was an in-vitro design entailing microbial cultures under standard conditions and assessment of antibacterial efficiency by agar plate diffusion method.[3,5,10, 12, 15, 16, 17, 18] It is considered as a standard primary in vitro test of a new agent to assess its efficiency.

There was no statistically significant difference between the antibacterial efficiency of 10% P guajava extract and 0.2% Chlorhexidine gluconate against Streptococcus mutans and Enterococcus faecalis. This shows that both organisms have similar susceptibilities to both P guajava extract and chlorhexidine gluconate (Table 2). When the other concentrations were evaluated against 0.2% chlorhexidine there were statistically significant differences. 50% guajava extract showed a larger zone of inhibition and 5% and 0.2% concentrations showed smaller inhibition zones against both test organisms (Table 3). The crude extract of P guajava has antibacterial action against both oral cariogenic Streptococcus mutans and endodontic pathogenic Enterococcus faecalis.

Conclusion

Natural plant extracts and products contain many active antibacterial agents that are beneficial to prevent diseases. From this study it can be concluded that P guajava extract has antibacterial properties against Streptococcus mutans and Enterococcus faecalis. Crude extract of guajava is not as effective as chlorhexidine when used at lower concentrations. The antimicrobial inhibition of Streptococcus mutans and Enterococcus faecalis suggests that P guajava can be used as an anticariogenic agent and as an intra-canal irrigant in endodontic preparation.

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Biomedical waste management

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Abstract

The waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of wastes. Therefore safe and reliable methods are needed for its handling and disposal. Inadequate and inappropriate handling of health care waste may have serious public health consequences and a significant impact on the environment.

This article describes the various categories of biomedical waste (BMW) and the techniques available for their disposal. A centralized or common BMW treatment facility has definite advantages over institutional BMW management facilities, especially in a developing economy like ours. In this article, we discuss the concept of common BMW management facility, which is available in Kerala through IMAGE (Indian Medical Association Goes Ecofriendly).

Introduction

Biomedical Waste (BMW) means any waste, which is generated during the diagnosis, treatment or immunization of humans or animals, or in research activities pertaining thereto, or in the production or testing of biologicals.[1]

The waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of waste. Exposure can result in disease or injury because BMW contains infectious agents (especially HIV and Hepatitis B and C), toxic or hazardous chemicals, sharps, genotoxic and radioactive materials. [2, 3, 4]

The Government of India passed the Biomedical Waste (Management & Handling) Rules, 1998, according to which, it is the duty of every "occupier" of an institution and its premises to take all steps to ensure that waste generated is handled without any adverse effect to human health and environment.[5] While healthcare concerns, by themselves, are a costly affair, BMW disposal is an even more cost-sensitive issue. Institutions can either have their own waste treatment facility or a common facility can be used for a particular area. In Kerala, the Indian Medical Association has installed a common biomedical waste treatment and disposal facility, named IMAGE (Indian Medical Association Goes Ecofriendly).

The World Bank's Health Care Waste Management Guidance Note lists four steps to healthcare waste management: 1) segregation of waste products into various components that include reusable and disposable materials in appropriate containers for safe storage; 2) transportation to waste treatment and disposal sites; 3) treatment; and 4) final disposal.[4, 6]

Segregation of Waste Products

As 80-85% of waste generated in hospitals is non-hazardous or general waste, segregation will reduce the quantum of waste that needs special treatment to only 15-20% of the total waste.[2] According to Biomedical Waste (Management and Handling) Rules 1998, categories of BMW in India are given in Table I: [1,7, 8]

General waste like garbage, garden refuse etc. should join the stream of domestic refuse. The different categories of BMW are to be segregated into appropriate colour coded containers.[1,8,9] (Table II)

Transportation To Waste Treatment And Disposal Sites

Once segregated into proper colour coded containers, BMW can either be treated on site or transported to another site for treatment and/or disposal. Biomedical waste should be transported within the hospital by means of wheeled trolleys, containers or carts that are not used for any other purpose. The wheeled containers should be designed such that the waste can be easily loaded, remains secured during transportation, does not have any sharp edges and should be easy to clean and disinfect.[10,11] Off site transportation vehicle should be marked with the name and address of the carrier. Biohazard symbol should be painted on the vehicle.[2,5]

Treatment and Disposal Technologies

There are many options for treatment and disposal, because medical waste varies in its characteristics and

Table I: *Categories of Biomedical Wastes in India*

Cat. No. 1	Human Anatomical Waste (human tissues, organs, body parts)
Cat. No. 2	Animal Waste (Animal tissues, organs, Body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals/ colleges, discharge from hospitals, animal houses)
Cat. No. 3	Microbiology & Biotechnology waste (wastes from laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research, and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)
Cat. No. 4	Waste Sharps (needles, syringes, scalpels blades, glass etc. that may cause puncture and cuts. This includes both used & unused sharps)
Cat. No. 5	Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)
Cat. No. 6	Solid Waste (Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, line beddings, other material contaminated with blood)
Cat. No. 7	Solid Waste (waste generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.)
Cat. No. 8	Liquid Waste (waste generated from laboratory & washing, cleaning, house-keeping and disinfecting activities)
Cat. No. 9	Incineration Ash (ash from incineration of any bio-medical waste)
Cat. No. 10	Chemical Waste (chemicals used in production of biological, chemicals, used in disinfect ion, as insecticides, etc)

❖ *Adapted from Biomedical Waste (Management & Handling) Rules, 1998*

degree of risk and because treatment methods vary in their capabilities, cost, availability to generators, and impacts on the environment. [2, 4, 11, 12]

1. Incinerators: Incineration is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very significant reduction of waste volume and weight.

2. Chemical disinfection: Chemicals are added to waste to kill or inactivate the pathogens it contains. Chemical disinfection is most suitable for treating liquid waste such as blood, urine, stools, or hospital sewage. The commonly used disinfectants are aldehydes, chlorine compounds, ammonium salts, and phenolic compounds.

3. Wet and dry thermal treatment

a. Wet thermal treatment: Wet thermal—or steam—disinfection is based on exposure of shredded infectious waste to high-temperature, high-pressure steam, and is similar to the autoclave sterilization process. It inactivates most types of microorganisms if temperature and contact time are sufficient.

b. Screw feed technology: Screw-feed technology is the basis of a non-burn, dry thermal disinfection process in which waste is shredded and heated in a rotating auger to a temperature of 110-140°C. The residues are compacted and reduced by 80% in volume and by 20–35% in weight.

c. Microwave irradiation: Most micro-organisms are destroyed by the action of microwaves of a frequency of about 2450 MHz and a wavelength of 12.24cm. The water contained within the wastes is rapidly heated by the microwaves and the infectious components are destroyed by heat conduction.

4. Land disposal: If a municipality or medical authority genuinely lacks the means to treat wastes before disposal, the use of a landfill has to be regarded as an acceptable disposal route; which is much better than accumulation of BMW in hospital premises.

a. Open dumps are characterized by the uncontrolled and scattered deposit of wastes at a site; this leads to acute pollution problems, fires, higher risks of disease transmission, and open access to scavengers and animals.

b. Sanitary landfills are designed to have at least four advantages over open dumps: geological isolation of wastes from the environment, appropriate engineering preparations before the site is ready to accept wastes, staff present on site to control operations, and organized deposit and daily coverage of waste.

Table II: *Colour coding and type of container for disposal of biomedical wastes*

Colour Coding	Type of Containers	Waste Category	Treatment Options as per Schedule 1
Yellow	Plastic bag	1,2,3,6	Incineration/deep burial
Red	Disinfected Container/ Plastic bag	3,6,7	Autoclaving/Micro waving/ Chemical Treatment
Blue/ White translucent	Plastic bag/puncture proof container	4,7	Autoclaving/Micro waving/ chemical treatment and destruction/shredding
Black	Plastic bag	5,9,10 (Solid)	Disposal in secured landfill

❖ *Biomedical Waste (Management & Handling) Rules, 1998*

***c. Safe burial on hospital premises*:** In remote locations or in temporary refugee encampments, the safe burial of waste on hospital premises may be the only viable option available at the time.

After disinfection or incineration, infectious health-care waste becomes non-risk waste and may be finally disposed off in landfill sites.

5. Inertization: The process of "inertization" involves mixing waste with cement and other substances before disposal in order to minimize the risk of toxic substances contained in the waste migrating into surface water or groundwater. It is especially suitable, for pharmaceuticals and for incineration ashes with a high metal content.

Centralized BMW Management in Kerala

Health care institutions can either have their own waste treatment facility or a common facility can be used for a particular area. Individual treatment facilities can be very expensive, especially in developing economies, and if equipments like incinerators are not well maintained, they only add to the environmental pollution through emission of noxious gases. In such a scenario, common or centralized BMW disposal facilities is a more viable option, where the concept is of users sharing the cost.

Kerala has the highest number of health care institutions in India as per the 1991 census. About 26% of total health care institutions in India are located in Kerala. It is roughly estimated that about 1.3 to 2.0 kg/ bed/day of solid wastes are generated from health care institutions of which 15 to 20% are BMW. [8, 11]

IMAGE is a Common Bio Medical Waste Treatment and Disposal Facility of IMA in Palakkad district, Kerala situated in 23 acres of land. The plant was set up as per the decision of the Central and State Pollution Control Boards to have common bio-medical waste disposal system. It serves all the 14 districts in Kerala.[13]

The IMAGE gives training to health care workers of hospitals on proper segregation of BMW into appropriate colour coded containers, precautions to be taken while handling the biomedical waste, storage of biomedical waste, use of needle destroyers etc. The segregated and labelled waste is then collected from all the affiliated institutions every day and transported in vehicles marked with the Bio-Hazard Symbol. The same is treated and disposed off scientifically as per regulations.

IMAGE handles more than one third of Kerala's biomedical waste. Service charges amount to Rs.3.50/- per bed per day. Government healthcare institutions are served through an Memorandum of Understanding (MOU) with Government of Kerala. The number of health care institutions affiliated to IMAGE has grown from 369 institutions and 9712 beds in 2005 to 1166 institutions and 33698 beds in 2007.[13]

Similar common facilities in other parts of the country include "Safenviron" a proprietary firm identified by Andhra Pradesh pollution control board (APPCB) and the Brihanmumbai Municipal Corporation (BMC) which apart from general municipal waste also handles BMW in Mumbai.[14,15]

CENTRALIZED versus INDIVIDUAL treatment of BMW

Individual hospital biomedical waste treatment is favoured by generators who want more control over the treatment and disposal of their wastes and their associated liabilities. On-site treatment is also the choice of institutions that are distant from a common service facility, where transportation could be a problem. However, on-site waste treatment has the burden and

costs of operation, maintenance, and final disposal of the treated waste. In addition, it requires separate manpower and infrastructure development for proper operation and maintenance of treatment systems. Except for very large institutions, on-site incinerators might not be fully put into use.[4]

The concept of centralized or Common Biomedical Waste Treatment Facility (CBWTF) [15] not only addresses such problems but also prevents proliferation of treatment equipment in a city. In turn it reduces the monitoring pressure on regulatory agencies, and also the potential for release of noxious gases from too many incinerators. By running CBWTF, the cost of treatment of per kilogram of waste gets significantly reduced, which is especially beneficial in developing economies. Moreover, in our country there are a lot of smaller private hospitals and clinics, than there are large multispecialty hospitals. In such a setup the importance of centralized waste management programs cannot be overemphasized.

Conclusion

All hospital waste should be treated as hazardous and the policy of waste management must be followed rigidly. Creating awareness amongst the health care providers is important for responsible management of biomedical wastes. In developing economies like India, the issue of increased cost of proper waste disposal may be solved by central facilities for waste management. More legislations and regulations specific to the handling of BMW should be enacted and more of centralized waste management facilities should be encouraged by the Government in all parts of the country.

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An in vitro evaluation of the effect of a self- etching primer on the shear bond strength of orthodontic brackets

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Abstract

Background: This study evaluated the bond strength of a commercially available self etching primer system and compared it with a conventional etching adhesive system.

Methods: A case – control study on forty human premolars and forty stainless steel contoured Begg brackets was done to test shear bond strength of teeth. Transbond plus™ Self Etching Primer and Transbond™ XT Light Cure Adhesive paste on experimental group was compared to Scotchbond™ etchant, TransbondTM XT Light cure adhesive primer and Transbond™ XT Light Cure Adhesive paste on control group. The maximum load, the breaking loads were recorded. Student t test was used to compare the bond strength between the groups.

Results: The mean shear bond strength was 16.77± 2.87 MPa and range was 10.9192 for the control group. The mean shear bond strength of experimental group was 11.707±2.49 MPa and range was 10.2049. A statistically significant difference was observed in the mean breaking load values between cases and controls ($P < 0.05$).

Conclusions: The bond strength obtained for self etching primer is lower when compared to that of the conventional etching system. Current advances in orthodontic materials and techniques to make orthodontic treatments more patients friendly. Hence, the self etching primer may have additional benefits in orthodontic field.

Introduction

Material science related to orthodontics has seen a sea of change in the last decade. Since inception, bonding in orthodontics has undergone considerable improvement with time. Rapid strides in technology and material science coupled with the endless search for "the ultimate adhesive system" have yielded a multitude of adhesives that provide adequate bond strengths on normal and abnormal tooth surfaces.

Conventional adhesive systems used in orthodontic bonding involve 3 different agents (an enamel conditioner, a primer solution, and an adhesive resin). A unique characteristic of some new bonding systems in operative dentistry is that they combine the conditioning and priming agents into a single acidic primer solution for simultaneous use on both enamel and dentin to result in improvement in both time and cost-effectiveness to the clinician and, indirectly, to the patient. This same type of material is now available for orthodontic bonding claiming better bonding to enamel surface.

Now-a-days many orthodontic companies have come out with different types of self etching primer adhesive systems claiming better bond strength, saving chair side time and also cost-effectiveness to the clinician and, indirectly, to the patient.

This study was carried out to objectively and professionally evaluate the bond strength of a commercially available self etching primer system and to compare it with a conventional etching adhesive system.

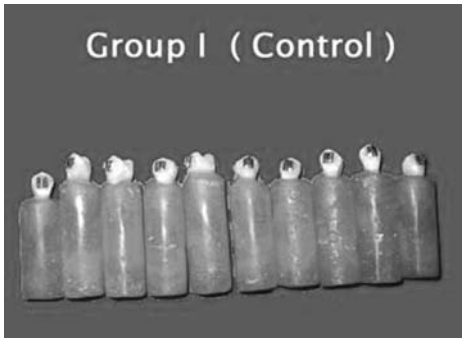
The aims of the present study include:

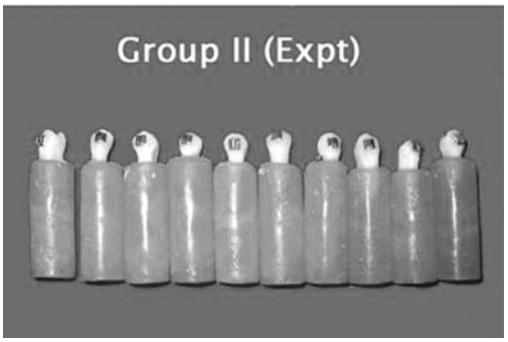
1. To measure the shear bond strength of stainless steel brackets bonded to enamel in vitro with a recently developed self-etching primer.
2. To compare its shear bond strength with conventional 3 component adhesive bonding system.

Materials and methods

This study used 40 human premolar teeth that were extracted as a part of orthodontic treatment. The criteria of tooth selection were as follows: the crowns were grossly perfect, without caries, and had not been treated with chemical agents, such as hydrogen peroxide, alcohol or formalin. The teeth were randomly divided into two groups – experimental group and control group with 20 teeth each. The study was approved by the Institutional Ethics Committee, Govt. Dental College Calicut, Kerala, India and informed consent was obtained from the subjects.

Of the 40 premolars, 24 were upper premolars and





16 were lower premolars. All the samples were healthy and without carious lesions, with no evidence of surface defects or any developmental morphological aberrations. After extraction, the teeth were washed, immersed in physiological saline, and stored in a closed plastic box until testing. All the samples were embedded in a cylindrical acrylic block of polymethyl methacrylate (PMMA) so that only the coronal portion of the specimen was exposed. The crowns were oriented along the long axes of the block and were stored in distilled water at room temperature in a closed airtight container. The samples in each group were randomly selected from the container. The fluid media was changed at periodic intervals in order to prevent the growth of bacteria and subsequent contamination of the sample.

Forty new Stainless steel contoured Begg (Series 256-500) brackets with bondable bases of approximately 3.42mm in length and 3.31mm in width were used for the purpose. All the brackets were of uniform size manufactured by TP orthodontics Inc., LaPorte, Indiana.

Transbond plus™ Self Etching Primer (is a unit dose system, with etchant, primer, and micro brush sealed in a triple lollipop- shaped aluminium foil package) was used in conjunction with Transbond™ XT Light Cure Adhesive paste (3M Unitek) for the experimental groups. The chemistry of Transbond Plus™ Self- Etching Primer[40] is similar to that of phosphoric acid, with two primer chains that form a solid primer matrix upon curing. The traditional 3M Scotchbond™ etchant (3M ESPE Dental Products, St Paul, Minn) was used in conjunction with Transbond™ XT Light cure adhesive primer (3M Dental Products) and Transbond™ XT Light Cure Adhesive paste for the control group.

The teeth in the control group were rinsed with tap water by using an air/water syringe for 20 seconds, cleaned with a nonfluoridated oil free pumice for 30 seconds, rinsed for an additional 20 seconds, and dried with oil-free compressed air for 20 seconds. The traditional 3M Scotchbond etchant with 35% phosphoric acid was applied to the buccal surface for a period of 15 seconds. The teeth were then rinsed for 15 seconds and warm air dried for 5 seconds. A layer of primer was applied to the etched surface and on bracket base before bonding. The adhesive was spread on the base of Begg brackets which were placed on the mid-buccal surface of the crown and firm seating pressure was applied until bracket to tooth contact was achieved. Any excess material was removed from around the bracket base. The specimens were then light cured (Hilux curing light) for a period of 20 seconds by shining the light for 10 seconds on each side (mesial and distal). After 10 minutes, the teeth were stored in distilled water for 48 hours at room temperature before debonding. (Fig. 1)

The teeth in the experimental group were rinsed initially similar to the control group and excess water was removed. The enamel was treated with Transbond Plus Self etching primer, which was gently rubbed onto the surface for approximately 3 seconds with the disposable applicator supplied with the system. A moisture-free air source was used to deliver a gentle burst of air to the primer. The primed enamel surface had a uniform shiny appearance. The bracket was bonded within 15 seconds of priming with the same bonding resin and curing light as for the control group.

The bonded samples were then stored in distilled water at room temperature in sealed containers lined with wet paper towels. After 48 hours, shear bond strength of teeth were tested using a Universal Test Machine manufactured by the Shimadzu Co-operation Japan [AG-1 series]. The testing was done at a temperature of 28°c. The acrylic block with the teeth embedded having bonded brackets were placed at the base of the test machine. The whole unit was stabilized using clamp tightened with screw at base. The blade was directed towards the base of the bracket or the bracket adhesive interface. The blade was moved towards the bracket with a crosshead speed of 1mm/min. The maximum load, the breaking loads were recorded electronically in Newton and converted to Megapascals. (Fig: 2)

Results

The descriptive statistics for the bonding strength of two groups were calculated and recorded in MPa. The mean, standard deviation, and minimum and maximum values were calculated for each of the 2 test groups. The Student t test was used to determine whether

significant differences were present in the bond strength between the 2 groups. The P value < 0.05 was considered as statistically significant.

In control group, the mean shear bond strength was 16.77 MPa with a standard deviation of, 2.87 and range was 10.9192. The mean shear bond strength of experimental group was 11.707 MPa with a standard deviation of 2.49 and the range was 10.2049 (Table 1).

There was a statistically significant difference in the Breaking Load values (in Mpa) between control group and experimental group was done (P<0.05)(Table 2).

Discussion

This study was undertaken to determine whether Acidic Primer system-Transbond Plus™ Self Etching Primer (3M Unitek) would produce a clinically acceptable bond strength and to compare the bond strength of this material with those of a commonly used composite resin, Transbond XT™ Light Cure Adhesive through an in vitro assessment.

The mean shear bond strength of the control group in our study was quite higher than the optimum bond strength recommended for clinical use. Similarly, Cehreli ZC et al in 2005 [1] compared the shear bond strength of 4 self-etching primer and adhesive formulations, a non rinse conditioner and acetone adhesive system, and a conventional Transbond XT™ system.The shear bond strengths of the 5 experimental groups were all significantly lower (P < .05) than that of the control group. Such high values may not be reachable intraorally as obtained in an In-vitro study for the fact that clinically we face more compromised situations and contamination and patients variables. This also leads credence to the fact that Transbond™ XT is one of the top notch products among light cured adhesives.

The mean value of the shear bond strength of experimental group in this study decreased significantly when compared to control group. This indicates that the use of a self-etch primer to bond orthodontic brackets to the enamel surface provided lower, but clinically acceptable, shear bond forces. The exact cause of the decreased bracket bond strength for the Self Etched Primer (SEP) compared with that of the conventional two-stage bonding system is unknown. Possible reasons may be the difference in chemical composition and concentration of the etchant between the two systems. The mode of etching/priming between the two bonding systems is different (simultaneous etching/priming with the SEP versus separate etching and priming stages for the conventional two-stage bonding system). This pattern was similar to the findings of Bishara et al[2] in which he compared two bonding systems. The shear bond strength of self etching primer used in another study of Samir E Bishara[3, 4] was very less compared to the present study. The reason for such low shear bond strength values could be due to the use of orthodontic adhesives that might not be compatible with the acidic primers. Bishara had used the orthodontic adhesive Transbond XT (3M Unitek) in both the groups bonded with 37% phosphoric acid etching and acidic primer system (Clearfil Liner Bond 2, J.C. Moritta Kuraway, Japan), both these materials are manufactured by different manufacturers and were not recommended to be used together. In the present study we used the materials by same manufactures, the bond strength of acidic primers were significantly lower when compared to conventional system, but clinically acceptable, shear bond forces when compared to conventional bonding systems. Iijima M et al 2008[5] sought to assess the efficacy of two self-etching primer systems (Transbond Plus and Beauty Ortho Bond) on orthodontic brackets. Under SEM examination, both self-etching primers showed a milder etching effect and decreased depth of resin penetration into intact enamel than Transbond XT.

The clinical importance of the present study is that this self-etching primer system had provided a significantly lower bond strength (11.707 Mpa) while comparing to the conventional bonding system. Reynolds in 1975 suggested that shear bond strength of approximately 5-8 MPa was adequate for clinical success. Even though the shear bond strength of self etching primer is significantly lower than conventional bonding system in the present study, it is clinically acceptable, as it is higher than Reynolds value. In contrast to the conventional bonding system the Self etching primers function both as an etching agent and a Primer. Here the rinsing of enamel is not required after application. Thus the use of Transbond Plus™ Self Etching Primer is thought to simplify the clinical handling of adhesive systems by combining the etching step with primer application in one mix. As the separate acid-etching and water-rinsing steps are eliminated and the application of self etching primer requires only simple drying with air it reduces the clinical steps, saves clinical operation time and increases the patient comfort by reducing the time that the patient has to keep the mouth open while doing bonding procedures. Hence the use of Transbond Plus™, which is easy and reliable, allows the orthodontist to simplify the orthodontic bonding.

However, it can be extrapolated from the present study that the use of self etching primer system is not recommended in certain clinical situations where the demand for bond strength is higher like class II div 2 malocclusions, cases having occlusal interferences, traumatic occlusions, severe deep bites etc Also for the patients with deficient and defective enamel which are known to reduce the bond strength over otherwise are not suitable candidates for self etching bonding system.

In conventional bonding system, the success of bonding to enamel is negatively affected by contamination with oral fluids such as blood, plasma

Table I - *The descriptive statistics for the bonding strength for experimental and control group*

Groups	No. of specimens	Mean ±SD Maximum load	Mean ±SD Breaking Load (Newtons)	Mean ±SD Breaking Load (Mpa)	Range
Control group	20	191.5489 ± 31.02187	187.7787 ± 32.12252	16.7656 ± 2.868026	10.9192
Experimental group	20	129.1995 ± 28.4687	125.6042± 30.13397	11.70703 ± 2.485381	10.2049

Table 2-Inter group comparison and level of significance

Observation MPa Base line	Mean	S.D	T – value	P – value
Control group	16.77	2.87		
Experimental group	11.707	2.49	6.313	<.001

etc. A reduction of approximately 50% in the mean shear bond strengths when the resin composite adhesive was bonded to contaminated etched enamel surfaces when compared with the uncontaminated etched enamel surfaces. Possibly, the self etching primer usage would have been a blessing in certain clinical situations like with surgically exposed impacted/unerupted teeth or bleeding from inflamed and hypertrophied gingiva where the chair side time and keeping the field dry is critical. Turk T et al in 2007[6] evaluated shear bond strengths (SBSs) of Transbond Plus to Transbond XT following saliva contamination at different stages of bonding at debond times of 5, 15, and 30 minutes and 24 hours. The highest SBS was obtained at a debond time of 24 hours for the control group. This was significantly different from the other groups.

As the shear bond strength obtained for the self etching system is significantly less than the conventional system in the present study, the use of self etching system in the contaminated clinical conditions(oral fluids such as blood, plasma etc) where further reduction in bond strength will occur should not be recommended. Findings of the study further points to the fact that the improvement of the formulations and techniques of self etching primer system should be done so as to makes its use viable in compromised fields of bonding where reducing the step will be much more beneficial for the patient.

Current advances in orthodontic materials and techniques are to reduce the patient discomfort and to make the orthodontic treatments more patients friendly. From that view point, the self etching primer is definitely an additional development in orthodontic field.

The following conclusions can be drawn from the present study: The bond strength obtained for self etching primer was than the conventional etching system but, was greater than that required for the clinical acceptability; this new material can be used successfully for bonding in normal cases. However, the use of self etching primers cannot be recommended in certain clinical situations which demand high bond strength and also in the contaminated clinical conditions (where further reduction in bond strength is likely to occur.

Based on the study, the further improvement in the formulations and techniques of self etching primer system (Transbond Plus™) can be suggested, so that it can be used even in compromised clinical conditions and for cases which demand high bond strength.

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A systematic approach to full mouth rehabilitation

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Abstract

Full-mouth rehabilitation of a mutilated dentition is always a clinical challenge. Accurate diagnosis, prudent choice of prosthodontic materials, and meticulous treatment execution are essential for a successful treatment outcome and prognosis. This article describes step by step approach in full mouth reconstruction.

Introduction

The personality of an individual is often judged by his looks. A beautiful smile always gives pleasure. However, the personality may be falsely interpreted by ugly and impaired teeth. The advancements in dentistry have made it possible to enhance the face value by improving the teeth through restorative and cosmetic treatment. The term 'full mouth rehabilitation' is used to indicate extensive and intensive restorative procedures in which the occlusal plane is modified in many aspects in order to accomplish "equilibration". Full mouth rehabilitation entails the performance of all the procedures necessary to produce a healthy, esthetic, well functioning, self-maintaining masticatory system [1].

Prudent clinical judgment and a careful balancing of the risks and benefits of various treatment options are essential for the long-term success of prosthodontic treatment.

Procedural steps in full mouth rehabilitation are as follows:

1. Case history and clinical examination
2. Diagnostic impression and cast
3. Face bow transfer and Interocclusal record
4. Diagnostic mounting on semi adjustable articulator
5. Evaluate vertical dimension and Occlusal interference for slide in centric.
6. Occlusal equilibration for removal of gross interference
7. Evaluation of crown height, retention form, surgical crown lengthening, intentional root canal treatment
8. Multidisciplinary approach
   Oral surgical- extraction
   Orthodontic-tilted teeth, rotation, intrusion, extrusion
   Periodontal – scaling, root planning, crown lengthening
   Endodontic – control of caries, root canal treatment
9. Establishing the vertical dimension of occlusion
10. Registering centric relation using hard wax. If vertical dimension of occlusion had to be increased, then centric relation record taken at increased vertical dimension
11. Mounting on articulator
12. Diagnostic wax-up at estimated vertical relation of occlusion
13. Centric jig fabrication using pattern resin at proposed vertical dimension of occlusion
14. Approach to full mouth rehabilitation : Quadrant wise or Segmental wise
15. Determine material for restorations
16. Shade selection
17. Prepare upper and lower posterior teeth using centric jig as guide in the anterior segment was used as an index to maintain the maxillary and mandibular relationship during teeth preparation.
18. Posterior segment relationships were recorded using bite registration paste.
19. Provisional restoration of all teeth, at an increased vertical dimension. Followed up for another six to eight weeks
20. Final impression of upper and lower posterior
21. Metal try in, checked on teeth for proper marginal integrity
22. Bisque try in
23. Temporary cementation of final posterior restorations
24. Prepare upper and lower anterior teeth and Provisionalization
25. Evaluate anterior plane for occlusion, phonetics, esthetics and function
26. Final impression of upper and lower anteriors
27. Metal try in
28. Bisque try in
29. Temporary cementation of final anteriors
30. Evaluation of anterior guidance, plane of occlusion, and occlusal scheme
31. Evaluate for function, esthetics and comfort
32. Final cementation of restorations
33. Maintenance phase
34. Follow up

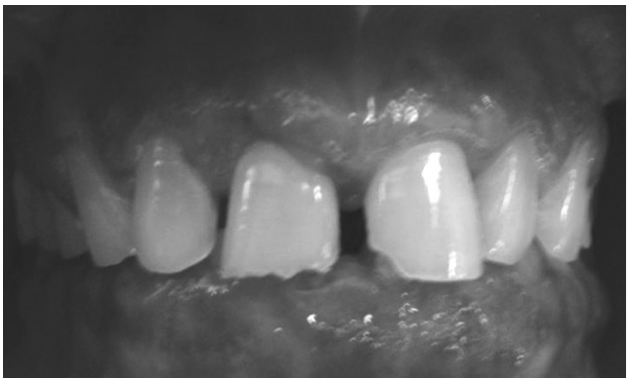

Fig. 1 a: Preoperative view

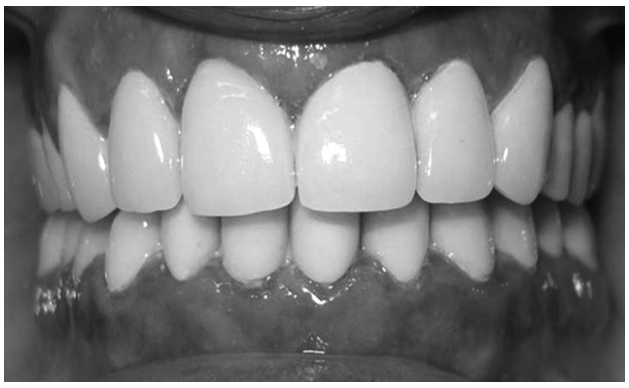

Fig. 1b: Postoperative view

Case reports:

Systematic approach of full mouth rehabilitation of two cases reported to our department is presented

CASE 1

- A 62 yr old male patient reported to the Dept of Prosthodontics GDC Trivandrum with difficulty in chewing, generalized sensitivity and wanted some cosmetic improvement of his teeth.
- On clinical examination there was marked attrition of the upper and lower dentition thereby significantly reducing the vertical dimension of occlusion. Evaluation of vertical dimension indicates a free way space of 9mm, hence intended to increase vertical dimension of occlusion by 4mm.
- Centric relation was recorded at increased vertical dimension using hard wax and mounted on the articulator. Centric jig at this increased vertical dimension of occlusion was fabricated using methyl methacrylate pattern resin (GC, Japan), which was used as a guide during teeth preparation and above described procedural steps were followed.(fig.1)

CASE 2

- A 23 yr old male patient suffered from considerable sensitivity and was very self-conscious about the appearance of his teeth was referred to the of Prosthodontics GDC Trivandrum for treatment. He was diagnosed with amelogenesis imperfecta
- Clinical and radiographic examination of the patient revealed discolored and had stained, pitted, and hypoplastic enamel, occlusal wear with exposed dentin in the posterior areas. except third molars
- Evaluation of vertical dimension found adequate free way space, hence not intended to change vertical dimension of occlusion.
- Centric relation was recorded at the existing vertical dimension of occlusion using hard wax and mounted on the articulator. Here also centric jig was fabricated using pattern resin, which was used as a guide during teeth preparation.(fig. 2)

Post-treatment therapy

After placement and cementation of prosthesis the patient treatment continues with carefully structured sequence of follow-up appointments to monitor the dental health, stimulate meticulous plaque control habits, identify incipient disease and introduce any corrective measures if required. Oral hygiene aids prescribed are tooth brushes, oral floss, interdental brush, oral irrigation devices and oral rinses. After maintaining adequate oral hygiene, patient is recalled at 1 month, 3 months, 6 and 12 months. After 1 year patient is recalled annually for check-up and prophylaxis.

Discussion

Occlusal wear is most often attributed to attrition. The causes for worn dentition are congenital abnormalities like amelogenesis imperfecta and dentinogenesis imperfecta, parafunctional occlusal habit like chronic bruxism, abrasion, erosion and due to loss of posterior support.[2] Excessive occlusal surface wear can result in occlusal disharmony, functional and esthetic impairment. Pulpal pathology may also accompany it. Occlusal disharmony manifests itself mostly as loss of occlusal vertical dimension and causes pathosis in the temporomandibularjoint and masticatory muscles.[3,4] The restoration of worn out dentition requires the need to recreate the interocclusal space lost as a result of compensatory eruption of opposing teeth during the process of tooth wear. Alteration of the vertical dimension of occlusion should be approached with great care and excessive changes of the vertical dimension of occlusion should be avoided.

Conclusion

The complete occlusal rehabilitation of worn out dentitions has been presented. In case 1, there was severe attrition with excessive loss of vertical dimension. Hence intended to increase the vertical dimension of occlusion, this provided space for the anterior restoration. In case

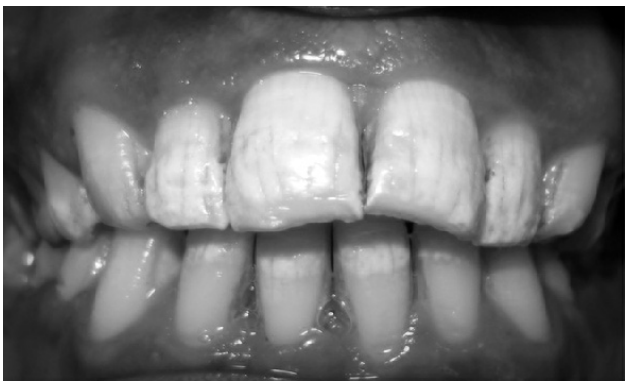

Fig. 2 a: Preoperative view

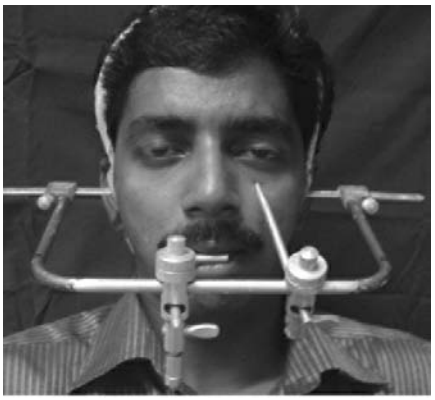

Fig. 2 b: face bow transfer

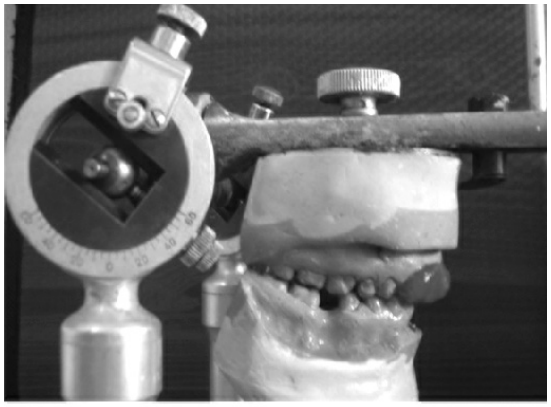

Fig. 2 c: Centric jig

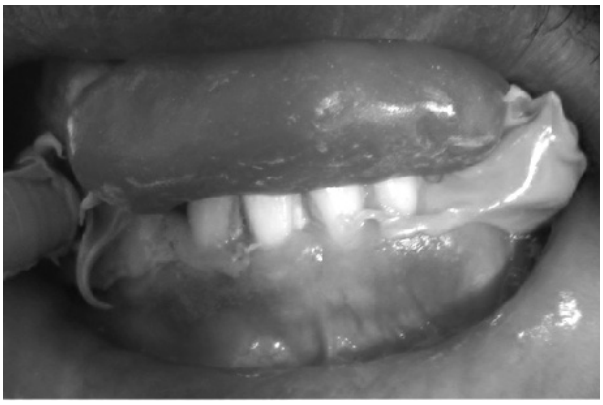

Fig. 2 d: Bite Registration

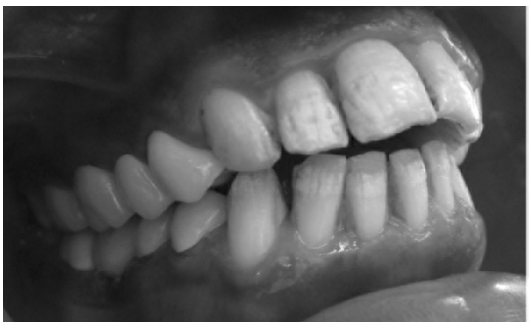

Fig. 2 e: Posterior segment cemented

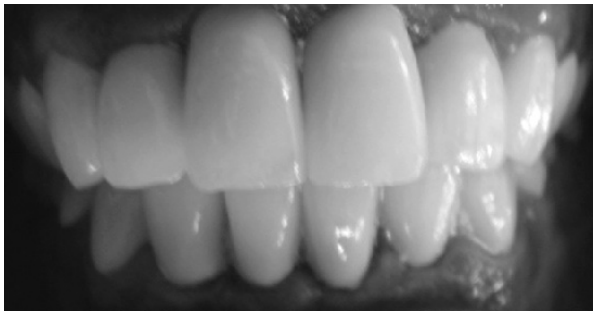

Fig. 2 f: Postoperative view

2 of amelogenesis imperfecta, there was a little change in vertical dimension. In both cases the centric jig was used as an index to maintain the maxillary and mandibular relationship during teeth preparation. This centric jig can also used during bite registration procedure which will help maintain maxillomandibular relationship with out error and thus achieves a successful occlusal rehabilitation.

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Information

Orthodontic separators

*** Sreehari S. Nair, ** Jayaram Mailankody, *** Namitha Sreehari**

Abstract

Separation of molars is utmost crucial in orthodontic treatment using a fixed appliance. This is necessary to create enough space for the bands that anchor the appliance. The ideal separator should give rapid and good separation without causing patient discomfort or pain, thereby making the fitting of the band to the tooth easy. Moreover, the separator should be easily cleaned, radio opaque and not to be lost. Different types of separators have been used in orthodontics like brass wires, latex elastics, and elastomeric and spring-type steel separators. During the past 10 years, springs and elastomerics have been the most used. This article zooms in to the current facts and figures of separation and their role in orthodontics.

Introduction

Separator is a device used to create separation between adjacent teeth. There are different kinds, but the principle is the same with any type of separator used: the separator is inserted so that it can force or wedge the teeth apart, and it is left in place long enough for initial tooth movement to occur. Thus banding can be performed by next patient visit. Separators also can be used to create space in which clasps or crossover wires of removable appliances (e.g. Fränkel appliance) will fit. However, only few studies have thoroughly investigated the separating/ tooth-moving effect for different separators and the patient response. *Ngan et al*[1] found that separators caused high levels of discomfort at 4 and 24 hours after placement, and that the discomfort was significantly reduced by analgesics.

Normally, adjacent teeth maintain tight interproximal contact point (CP) relationships with each other. Therefore, their separation is required for the placement of orthodontic bands. The average periodontal ligament (PDL) space is 0.25 mm. Placement of a 0.16-mm orthodontic band without proper separation will risk contact with alveolar bone, producing hyalinization areas in the PDL and evoking the pain response of resident mechanoreceptors. Moreover, the CP of posterior teeth is almost 3 times tighter than that of anterior teeth, so excessive force is required to place molar bands. Furthermore, it was reported that a quantitatively tighter CP exists at the distal aspect of these teeth compared with the mesial aspect.[2]

Brief review of literature

There is general agreement that adequate separation between teeth is necessary for good band adaptation. *Angle*[3] discussed the need for separation in 1907, and his method is still popular today. Angle explained the use of a brass wire ligature passed under the contact point, then carried on over the contact, after which the ends were tightly twisted together. He stated: "Such a ligature will not give annoyance from displacement so liable in the use of wedges, and if worn a few hours, it will be found that ample space has been gained for the accommodation of the band." Even at this early date, Angle was not describing anything new. Brass wire has been used for separation of teeth for restorative dentistry for many years.

In 1921 *Calvin Case*[4] advocated the use of a separating tape, which was flax waxed tape wrapped around the contact. He said that the tape should be left on for only 24 hours and then changed if separation was not sufficient.

Oliver[5] expanded the reasons for separation in the following manner

- To reduce physical pain to the lowest possible degree
- To prevent injury to the tooth structure from excess pressure
- To prevent injury of the soft tissue while forcing band material to place
- To reduce physical and mental tension of the patient by having the band material conveniently carried to place
- To prevent distortion of the band material by not, having to force it unduly to position during band construction.

Graber[6] reconstructed the duration of separation as a matter of personal preference. Descriptions illustrating exactly how the ligatures should be formed, how they should be held with pliers, and how they should be tied interproximally were given. No mention is made, however, about length of time these ligatures should be left in place or of the amount of space that will be gained.

In addition to the brass ligatures, rubber separators are mentioned by Dickson *Thurow*[7]. Both authors agree that these are far more painful to the patient. Thurow believes that rubber separators should be left for special

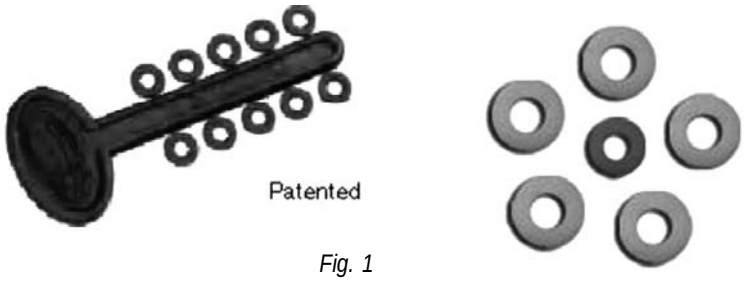

Fig. 1

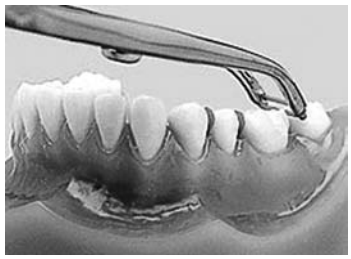

Fig. 2

situations where rapid separation is required. He believes that they should not be left in for long periods of time, since their action is not self-limiting.

Anderson[8] and *Begg*[9] describe separating springs. Anderson used them for very rapid expansion, were he used for several hours, Begg used them for several days. Begg is somewhat ambiguous when he states: "The separating springs are left in position for several days to allow sufficient time for separation of the teeth, but not long enough to allow the teeth to separate so much that the springs fall out. However, the springs are left in position until the discomfort of their separating action ceases."

According to the study conducted by *Hoffman*[10] the following conclusions were drawn

- Spring and brass ligature separators will give approximately 0.010 inch separation after 1 day and will maintain this amount thereafter.
- Plastic and latex elastic separators also give approximately 0.010 inch of separation the very first day and then continue to separate until removed.
- The latex elastics were most frequently lost, sometimes disappearing subgingivally below the contact. If these are left in that position, serious damage to the supporting tissues could result. The brass ligatures were least frequently lost.
- During separation the plastic elastics were the least painful, and the latex elastics were the most painful.
- The brass and plastic separators left the teeth, the least sensitive to band seating pressure, and the latex elastics left the teeth, the most sensitive.
- After 3 days of separation, there was a noticeable decrease in tooth sensitivity, regardless of the type of separator.
- The spring and brass separators collected the most food debris, while the latex and plastic elastics remained the cleanest.

According to *Bondemark et, al*[11], on pain or discomfort, the elastics were a little more painful than the springs, but the difference was not significant. After placement, the pain gradually increased with both separators, peaking on day 2, gradually subsiding on the third day, and almost gone on day 5 the separation effect of 2 types of separators was considered clinically equivalent. Molar band fitting should be done at least 5 days after placing the separators.

Types of separators

• Brass separator

A piece of soft 0.020-inch (0.51-mm) brass wire is bent in the shape of a hook. The flattened edge of the hook is passed beneath the interproximal contact and slid around it. The two free ends of the separator wire are then grasped with a pair of Mathieu pliers or a hemostat and twisted tightly, so a separating force is created. The twisted end of the separator ("pigtail") is cut to a length of approximately 3 mm and tucked in the interproximal area. Normally separate sizes of 22 G for molars and 26 G for anteriors are used.

• Elastic separator ["Donut", Fig 1]

Polyurethane Elastomeric ring of varying thickness is placed around the interproximal contact point to create the necessary separation over time. The elastomeric ring is stretched with the help of special pliers or by pulling apart two pieces of dental floss threaded through it, while it is forced through the contact [Fig 2]. An elastic separator (as any separator) can cause problems if lost into the interproximal space. Because the older separators were usually radiolucent, their position and number should be noted in the chart at the time of placement and the area thoroughly inspected in case of a missing separator at the banding appointment. They are also indicated some times to help disimpact blocked second / third molars as an initial step prior to fixing of attachments.

- Elastic threads can also be used as separator similar to elastomeric rings but by tying
- Spring-clip separator (Keslings, T P separators, Fig 3)

A spring is made of 0.020-inch (0.51-mm) stainless steel wire with a small helix. The spring is grasped using a plier next to the helix, at the base of its shorter leg. The bent-over end of the longer leg is placed in the lingual embrasure between the two teeth to be separated and the spring is pulled open so that the shorter leg can slip beneath the contact, with the helix on the vestibular side. Stainless steel spring separators are tolerated easily by the patient, but they tend to come loose and may fall out as separation of the teeth occurs. It is available in four lengths: Short, Medium, Long, And Extra long

"C" Separation Maintainers

Preformed brass separation maintainers are placed around contact areas of posterior teeth to maintain

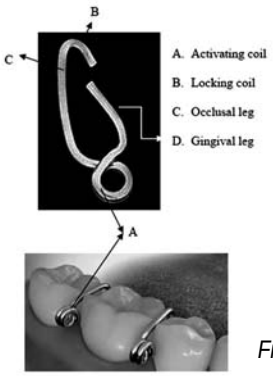

Fig. 3

Fig. 4

Fig. 5

space. Often used during intervals between banding appointments to hold space. Fabricated from 0.81 mm (.032") brass wire. (Fig 4)

• **Maxian elastic separator [dumbbell]**

This type of separator resembles a wide rubber band with thick, rolled edges. They are obtained in strips and cut to size by the operator, to accommodate the various teeth. The two rolled edges are stretched apart, making the interconnecting rubber, thin enough to be forced into the interproximal space. Maxian separators are capable of producing rapid separation. They are recommended to be placed 30 minutes before band fitting. But can be quite painful for the patient.

Discussion

Tight interproximal contacts make it impossible to properly seat a band, thus some device to separate the teeth must be used before banding. Although separators are available in many varieties, the principle is the same in each case: a device to force or wedge the teeth apart is left in place long enough for initial tooth movement to occur, so that the teeth are slightly separated by the appointment at which bands are to be fitted. Separation can be painful, particularly for anterior teeth, and the necessity for separation must be considered a disadvantage of banding and its absence, an advantage of bonding.

From the patient's perspective, steel spring separators are the easiest to tolerate, both when being placed and removed, and separating the teeth. These separators tend to come loose and may fall out as they accomplish their purpose, being their main disadvantage and the reason for leaving them in place only a few days. Brass wire and elastomeric separators are the most difficult to insert, but are usually retained well when they are around the contact, and so may be left in position for somewhat longer periods. Because elastomeric separators are radiolucent, a serious problem can arise if one is lost into the interproximal space. It is wise to use a brightly colored elastomeric material to make a displaced separator more visible, and these separators should not be left in place for more than 2 weeks. Modern separators are radio opaque.

Elastomeric modules are the most common devices used today for tooth separation. The module is first stretched with a placement instrument, then "sawed" through the contact until the gingival portion of the separator passes the contact point. This method sometimes breaks the elastomeric module, causing tissue damage, or distorts the module, resulting in insufficient space for banding.

To prevent tissue damage, some clinicians thread two pieces of dental floss through the center of the module to stretch the separator on one side and then the other, until the occlusal portion of the separator, passes through the contact point. If the module breaks, the force is directed away from the gingiva. However, the time factor and patience required to thread dental floss through each elastomeric module can be prohibitive in a busy office.

Elastomeric modules work well in child and adolescent patients whose teeth are slightly mobile and free of restorations or adjacent bands. Adult patients commonly have tight contacts and/or sharp amalgam fillings with broad contacts that prevent placement of elastomeric modules without distortion or breakage. Crowns with improper proximal contouring (made without separable dies and without embrasures carved) are the most difficult once. In these cases T P Springs or brass wires may be used.

TP Springs are made of tempered stainless steel wire, usually .018" or .020" in diameter, and have the advantage of being easy to place in difficult contact areas. The hook of the spring is inserted into the lingual embrasure, and the shorter segment is opened with a plier to engage the opposite embrasure. Selecting too small a spring may result in distortion of the spring and thus insufficient space for banding. Too large a spring will jiggle around the contact area, causing tissue impingement and providing insufficient space.

Brass wire has been largely abandoned since the development of elastomeric modules and TP Springs. Patients, particularly adults, commonly complain of discomfort from metal separators. The discomfort often increases to pain, with many patients reporting inability to chew in the affected areas. The heavy force applied by the wire, tissue irritation from the coil or pigtail, and

occlusal interference are the primary reasons for these complaints.

Titanium alloys[12] offer a significant improvement over currently available materials for tooth separation, especially for adult patients or adolescents with tight contacts and/or amalgam fillings with broad contacts. Distortion is not a problem, as it can be with tempered stainless steel or elastomerics. The problem of breakage during insertion common to elastomeric modules is resolved. Reuse after autoclaving is also possible with nickel titanium springs (Fig 5). These springs are easy to place, are self-seating, produce minimal patient discomfort initially and during separation, are easy to remove, and generate sufficient space for banding. Reactivation is not required, although the separating springs produce less separation than elastomeric separators.

Currently, elastomeric modules are the separators of choice. These are commonly placed for several days or, usually, a week. Due to the continued force and occlusal interferences, elastomeric separators inevitably produce discomfort that can last the whole week. A clinical pain study recommended that the initial discomfort from elastomeric separator placement can be reduced by giving the patient 400 mg of ibuprofen orally 1 hour preoperatively. A gradual reduction of CP tightness often permits separator loss before banding appointment. This can occur during eating or brushing, and results in rebounding of the teeth, loss of interproximal space, and return to the initial CP tightness. This potential disruption of treatment, and patient discomfort brought about a refined protocol. *Davidovtich et al*[13] in 2008 put forward following suggestions

1. The greater the initial tightness between adjacent teeth, the less space is created at separator removal.

2. 8-hour separation regimen in patients with little to moderate contact point tightness and a 12-hour regimen in patients with great initial contact point tightness.

3. Separators should be placed a day before the bands are fitted; the patient should be instructed to come to the office 3 to 4 hours before the appointment for separator replacement if the separator was lost.

4. The proximity between separator placement and separator replacement in case of separator loss prevents the complete closure of the gained space and thus reduces the length of separator replacement.

5. A biphasic visco-elastic PDL recovery pattern was found when the separator was removed. Rapid recovery occurred within the first 4 hours after separator disengagement; recovery was slower in the next 20 hours, with 82% to 95% of the baseline tightness of dental contact point [TDCP] regained within 24 hours.

6. The full recovery of the PDL system demonstrates the biologic safety of the separation technique.

Conclusion

The function of an orthodontic separator is to provide adequate interdental space for banding with minimal trauma and discomfort to the patients. Of the currently available ones, elastic separator gives sufficient separation for placing orthodontic bands with an acceptable level of patient discomfort. Bonding the attachments, wherever possible may be another method to eliminate the cumbersome separation process

An attempt is hereby made to highlight some general guidelines in the use of orthodontic separators. The clinician may already be aware of the points discussed above. These guidelines may be modified, altered, or improved in light of clinical experience as and when the situation demands. An experienced clinician will naturally note limitations in generalizing this. However for the novice, this will be a helpful exposure while for the busy practitioner this will be a ready reckoner

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Case report

Atraumatic circummandibular wiring: a technical note based on clinical experience

*** Shiv Prasad Sharma, ** C.R. Sobhana, *** Narayanan Jayakumar, *** Dain Chacko Pearl**

Abstract

The management of paediatric mandibular fracture using an acrylic splint is a time tested procedure. Management of mandibular fractures in children differ from that in adults because of anatomic variation, rapidity of healing, degree of patient co-operation and the potential for changes in mandibular growth. The treatment of fractures in paediatric mandible is further complicated by the presence of numerous tooth buds throughout the body of the mandible. Trauma to the developing tooth buds may occur when carrying out open reduction. Splinting the fractured paediatric mandible with acrylic splint retained using circummandibular wiring is a viable option. The circummandibular wiring has also been used traditionally in stabilising the gunning splint used in treating mandibular fractures in elderly edentulous patients. In this publication we describe our clinical experience using a NO.16 IVCS(Intravenous Cannula Stylete) rather than traditionally used awl for circummandibular wiring.

Introduction

Paediatric maxillofacial fractures are relatively uncommon and carry different clinical features as compared to adults. Overall, facial fractures in the pediatric population comprise less than 15% of all facial fractures. They are rare below age 5 (0.6–1.4%).[1]

The general principles of the management of maxillofacial traumas are similar in both children and adults, but the ongoing developmental changes in the growing face of a child must be taken into consideration. Management of mandibular fractures in children differ from that in adults because of anatomical variation, rapidity of healing, degree of patient co-operation and the potential for changes in mandibular growth. The treatment of choice for fracture mandible in paediatric depends on the age and stage of tooth development and this has to be considered when deciding upon various options. In children the mandible cortex is thin and less dense than in adults, and the presence of tooth buds must be considered when planning open reduction.[2] Complications like infections, sensitization and even mutagenic effects warrant a second surgery for plate removal. For these reasons the use of bioresorbable fixation implants is a possible option. However, bioresorbable implants are not devoid of problems which includes poor mechanical properties, insufficient clinical scientific evidence regarding short term and long term characteristics and lack of ease in handling.[1,4]

In children the frequent absence of teeth due to exfoliation of primary teeth and poor retentive shapes of deciduous tooth crowns makes the traditional use of arch bars and interdental ligature splinting the fractured pediatric mandible with acrylic splint retained using circummandibular wiring is a viable option. Circummandibular wiring can be a useful technique for achieving closed reduction in patients who are edentulous or partially dentate.[2,3] We describe an atraumatic technique for placement of circummandibular wires using a No. 16 IVCS.

Technique

The plan was to stabilize the acrylic splint using circummandibular wiring at 3 locations: one in the anterior region and two in the posterior region. The circummandibular wiring was performed using a NO.16 IVCS instead of an awl.

STEP 1: The IVCS was passed percutaneously and exited in the lingual side close to the alveolus, a 26 gauge wire was passed through the lumen of the IVCS and clamped intraorally.

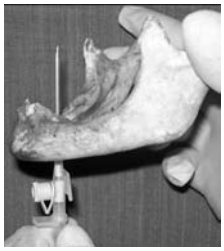
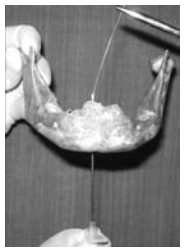
STEP 2: The needle was railroaded along the wire until the lower border of the mandible was felt.

STEP3 : The IVCS was then passed on the buccal side in proximity to the bone. During buccal insertion, the IVCS was rotated such that the bevel was on the leading side and the wire on the non-leading side.

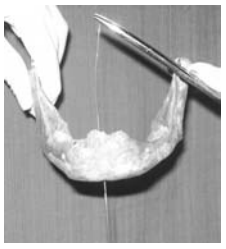
STEP 4: The needle and the excess wire within were removed after cutting the desired length of wire intra-orally.

Case report

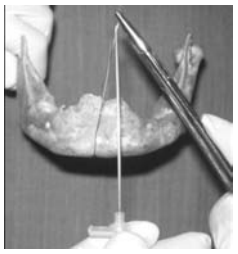
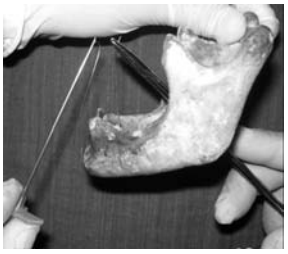
Four patients –Three paediatric (Age range 2-6 yrs) and one totally edentulous elderly female (Age 65 yrs),

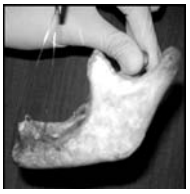
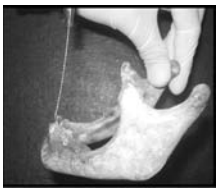
1. *Fig. 1A and Fig.1B; STEP 1: The IVCS was passed percutaneously* and exited in the lingual side close to the alveolus, a 26 gauge wire was passed through the lumen of the IVCS and clamped intraorally.



2. Fig.2; STEP 2: The needle was railroaded along the wire until the lower border of the mandible was felt.

3. Fig. 3A and Fig.3B; STEP3 : The IVCS was then passed on the buccal side in proximity to the bone. During buccal insertion, the IVCS was rotated such that the bevel was on the leading side and the wire on the non-leading side.

4. Fig.4A and Fig.4B; STEP 4: The needle and the excess wire within were removed after cutting the desired length of wire intra-orally.

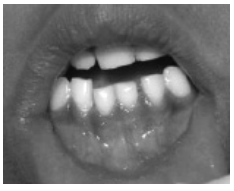


Fig.5A. Pre-op

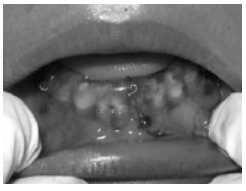


Fig.5B. Intra-op

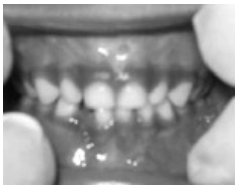


Fig. 5C. Post-op 6 weeks

who sustained mandibular fractures underwent closed reduction of their fractures using acrylic splint stabilized with circummandibular wires using the described technique. A Gunning splint was fabricated for the edentulous elderly female. Clinical examination revealed intra-oral deranged occlusion with step defect in the paediatric patients. However, in the elderly female patient, the fracture was minimally displaced with clinically detectable mobility. OPG were taken to confirm the fractures. In all the paediatric cases, the splint was allowed to remain in place for 3 weeks and in the edentulous patient the splint was allowed to remain for 6 weeks. Following the removal of the splints and the wires all these patients showed good occlusion and mouth opening. The cases were examined for size of the penetrating wounds, ease of technique and tissue penetration, post-operative edema and scarring.

Discussion

Conventionally, circummandibular wiring is performed with a mandibular awl, but the wound created when using an IVCS is inconspicuous compared with that created when using an awl. When the awl travels through the tissues, with the wire crimped, the twisted end of the wire causes trauma to the surrounding soft tissue because of its sharpness and thickness. Repeated use of an awl causes it to lose its sharpness When using an awl, the crimped wire, which is potentially contaminated by oral fluids, is made to pass around the mandible. Using IVCS the section of wire exposed to the oral cavity never touches the tissue, but the tip of the IVCS is exposed to the oral cavity and enters the tissue. All patients were followed up for 4-6 weeks. Fracture healing as uneventful and complications such as post operative swelling and hematoma were not observed.

An instrument that is sufficiently sharp, leaves a smaller wound, is disposable, economical and freely available would be a welcome alternative to the conventional awl. This article describes the technical modification of using a 16 gauge IVCS to place circummandibular wires.

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Information

Applications of zirconia in dentistry

* Anuroopa A., **Lovely M., ***James J. Rex, ****V.M. Shaju

Abstract

Among the various ceramic materials, zirconia based ceramics are widely used in today's clinical practice. This is due to its better strength and ability to achieve superior esthetics among all metal free restorations. In dentistry, zirconium oxide, in the form of yttria tetragonal zirconia polycrystals has been used for more than a decade. It is the physical and the biological behavior of the zirconia which makes it a preferred choice over the other ceramic systems. This paper gives an insight in to the various dental applications of zirconia in day to day practice.

Introduction

Zirconium is derived from the Syriac word zargono, Arabic word "zarkûn" and from Persian word "zargûn" meaning "gold like". It was discovered in 1789 by Martin Heinrich Klaproth, and was isolated in 1824 by Jöns Jakob Berzelius. Zirconia exists in pure forms as a crystalline soft white ductile metal and amorphous blue-black powder. The ores of zirconia are Baddeleyite (ZrO2), or part of complex oxide, such as the elpidita and the eudialital.[1]

Of nearly 20 minerals containing zirconium, only two are of commercial importance

(a) Zircon - zirconium silicate which is the primary source (b) Baddeleyite- zirconium oxide which is a minor source.

In 1975 the British physicist Ron Garvie published his research on the possibility of stabilizing the tetragonal structure of zirconium dioxide by adding about 5.5% yttrium oxide material which helped to achieve exceptional mechanical properties, high biological stability, and resistance to bending, shear strength and modulus of elasticity which reached values of steel. Therefore, this ceramic is also called 'ceramic steel'.[1]

Dental applications

Zirconium used in dentistry is yttrium stabilized zirconium oxide, which is an extremely hard ceramic material. Zirconia is used widely in the fabrication of dental veneers, crowns, inlays, onlays, endodontic posts, cores, orthodontic brackets, implant fixture and implant abutments[2].

Commercially available zirconia systems for crowns and bridges

· Lava zirconia from 3 M ESPE (Fig 1) - Lava zirconia substructure is available in eight shades and it provides excellent aesthetics with minimal reduction in strength or effect on translucency.

♦ Cercon system from dentsply (Fig 2) - Cercon Zirconia framework delivers an extremely strong translucent base, which is then coupled with highly aesthetic Ceramco veneering porcelain, creating a restoration with the fluorescence and translucency of natural dentition. Cercon's CAD/CAM technology produces a precise fit that can be conventionally cemented as in conservative porcelain fused metal preparation.

♦ Prismatik clinical zirconia (Fig 3) - It is a CAD/CAM ceramic with superior esthetics and consistent fit. The fracture toughness and flexural strength of zirconia are higher than that of alumina or any other all-ceramic and has a better esthetics without black lines at gingival margin.

♦ Tricon zirconia (Fig: 4) exclusively from Trident Dental Laboratories. These are precision milled crowns with optimal strength, perfect fit, superior strength and aesthetics.

♦ Procera crown zirconia (Fig: 5) from Nobel Biocare is intended for application for the higher load areas such as posterior teeth as it has extremely high flexural strength (1200 MPa). It comes in 0.7-mm thickness for use in all indications and 0.4-mm thickness for the aesthetic zone.

♦ Vita YZ- (Fig: 6) the YZ framework is milled on the Sirona in Lab system and it is further veneered with Vita VM 9 porcelain to create a highly aesthetic, all-ceramic restoration, the VITA In vizion.[3,4,5,6.]

Implant Fixtures and Abutment

Zirconium can be used as a dental implant material due to its superior hardness and biocompatibility [7].

Cera root Implant (Fig: 7)

Dr.Olivia from Barcelona in the year 2004 introduced the cera root implants with the zirconia implant fixtures[8]. These are manufactured in the following specifications- 11 for central incisors and canine, 12 for lateral incisors, 14 &16 for premolars and molars respectively.

TBR Group Implants (Fig: 8)

The TBR group implants are another category of

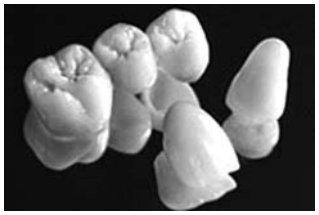

Fig: 1 Lava Zirconia

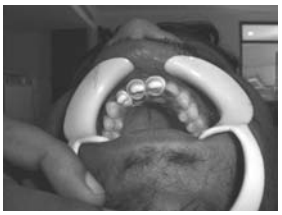

Fig: 2 Cercon CAD-CAM

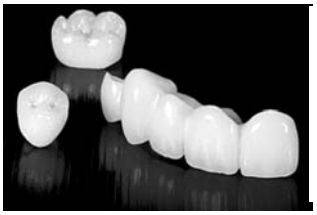

Fig: 3 Prismatik

Fig 4 Tricon

Fig: 5 Procera

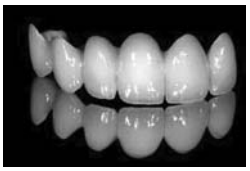

Fig: 6 Vita YZ

Fig: 7 Cera Root

Fig: 8 TBR Group Implant

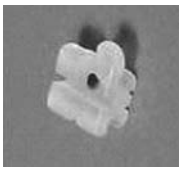

Fig: 9 Zirconia Brackets

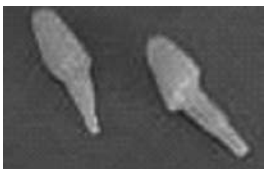

Fig: 10 Endodontic Posts

implant fixtures based on the concept of Periointegration where there is regeneration of gingival tissues along with osseointegration to provide a gingival cuff around abutment thereby enhancing esthetics. These implants have a titanium body with zirconium crestal module thereby forming a hybrid surface. An insoluble biocompatible nanometric molecular film between titanium and zirconia is formed. This union is the called the zirconnection, which prevent seepage of fluid. Zirconia attracts the fibro blast in addition to osteoblast and enhances the attachment of gingival cuff [9]

Biocomponent Abutments:

Abutment is a tooth, a portion of a tooth, or that portion of a dental implant that serves to support and or retain prosthesis[9] while biocomponent abutments are preferred material of choice for implants. Biocomponent abutments are implant abutments made of a titanium post luted to custom made zirconia abutment using anaerobic cements. These metallic zirconia abutments are esthetic abutments with a better physical properties as well as comparable marginal fit and good esthetics especially in the gingival margin.[10, 11]

Orthodontic Brackets: (Fig: 9)

Zirconia is widely used in the field of orthodontics. Clarity polycrystalline Ceramic brackets (3M Unitek 2724) showed higher frictional resistance compared to conventional or plastic brackets.[12]

Endodontic Posts (Fig: 10)

In endodontic, dowels made from fine grain dense tetragonal zirconia polycrystals are used. They are reported to possess high flexural strength and fracture toughness. Rosentritt et al reported that the fracture occurred primarily at bond between the core materials followed by dowels. Fracture threshold was higher for zirconia dowels when specimens prepared had a ferrule of 2mm length[13].

Conclusion

The advances in new technologies have greatly aided in the exploration of zirconia and its potential uses in various specialties of dentistry.

Zirconia definitely holds a lot of promise in the future for various technical and biomedical applications.

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Clinical report

Novamin® & 5% Potassium nitrate in the management of dentin hypersensitivity

*** Prakash Prabhakaran, ** Seema Jayakrishnan, ** Arun Sivadas, *** Smrithi Varma, **** Anita Susil**

Abstract

Background: Post periodontal surgery hypersensitivity is a common phenomenon in clinical practice. The market is flooded with various desensitizing tooth pastes for its management.

Materials and Methods: A case control study was conducted at a dental clinic in Trivandrum dist: and at the Dept: of Periodontics, Sri Sankara Dental College, Akathumuri, Trivandrum, among 47 patients affected with chronic generalized periodontitis in 2009-2010. Following periodontal flap surgery quadrant wise, Novamin® containing dentifrice was used in one quadrant and the same patient used 5% potassium nitrate containing dentifrice in another quadrant. Followed up on day 1 and day 7. Dentin hypersensitivity was recorded from 0 to 10 on a VAS scale.

Results and Conclusion: The mean difference of sensitivity for Novamin® (day 1- day 7) was 3.51(SD-1.38). The mean difference of sensitivity for 5% Potassium nitrate (day 1- day 7) was 1.51(SD-1.06). There was a significant difference between the two groups. Novamin® containing dentifrice has come to stay for the management of dentin hypersensitivity.

Introduction

Post periodontal surgery dentinal hypersensitivity is often a dilemma for the Periodontist. Many a patient have reported this unpleasant experience following periodontal flap surgery. Patients who suffer from severe dentinal hypersensitivity are very likely to be less compliant in post treatment instructions resulting in less favourable clinical outcomes. There are many studies evaluating the incidence of dentinal hypersensitivity. Some studies have reported rates as low as 8%,[1] whereas others as high as 93%.[2] Following periodontal flap surgery one study reported dentinal hypersensitivity in the range of 17% to 25%.[3] This wide fluctuation in the incidence may be due to various methods employed to assess dentinal hypersensitivity.

Objectives

The market is flooded with an assortment of desensitizing tooth paste claiming various degrees of efficacy in the management of dentin hypersensitivity. This study was to evaluate the effectiveness of 5% Sodium calcium phosphosilicate

(Novamin®) and 5% Potassium nitrate dentifrice in the management of post periodontal surgical dentinal hypersensitivity.

Mode of action

Sodium calcium phosphosilicate (Novamin®) is essentially bioactive glass which was identified as an alloplastic bone graft material. Novamin® is amorphous sodium calcium phosphosilicate developed as fine particulates. These particulates will mechanically occlude open dentinal tubules and release Ca and PO_4 to form biological apatite, which mineralize and strengthen tooth structure.[4] This reaction occurs within seconds of exposure and the release of Ca and PO_4 continue as long as the particulate is exposed to the aqueous environment.[5] The combination of Novamin® particulates and the newly formed hydroxy carbonate apatite layer result in physical occlusion of dentinal tubules which will reduce hypersensitivity. In addition Na and Ca have been demonstrated to reduce transmission of nerve impulses, thus reducing the stimuli to the dental pulp.[6] Recent studies have also shown Novamin® containing dentifrices and the particulates when mixed with water, alone possess a strong antimicrobial action against periodontal pathogens, that could be of significant benefit to the patient in periodontal maintenance therapy beyond simply desensitizing the root dentin[7]. In one experimental gingivitis study it was proposed that the material also have some local anti-inflammatory action as determined by a reduction in gingival inflammation. These properties of Novamin® make the material an attractive candidate for use with periodontal maintenance patients[8].

Materials and methods

This clinical study was carried out in 47 patients who had undergone periodontal flap surgery as part of management of chronic generalized periodontitis at a private clinic in Trivandrum dist: and in the Dept of

Characteristics of the study population and results

	Age	Sensitivity on day 1 with Novamin	Sensitivity on day 7 with Novamin	Sensitivity on day 1 with Potassium	Sensitivity on day 7 with Potassium
Mean	39.98	6.15	2.64	6.28	4.77
Median	39.00	6.00	2.00	6.00	5.00
Mode	46	7	2	6	5
Std. Deviation	6.138	1.841	1.421	1.570	1.747
Minimum	29	3	1	3	1
Maximum	51	9	6	9	8

Periodontics, Sri Sankara Dental College, Akathumuri, during 2009-2010. Informed consent was obtained and the usual routine medical protocol followed prior to surgery. This study was not funded by any tooth paste manufacturers and there is no conflict of interest.

Inclusion criteria[9]-

1. Male or Female patients in good general health.
2. Having chronic generalized periodontitis and undergone periodontal flap surgery.
3. Min: of 6 teeth in each quadrant.
4. No desensitizing toothpastes prior 6 months.
5. Following surgery quadrant wise had atleast one scorable sensitive tooth to cold water.

Exclusion criteria-

1. Unrestored cervical abrasion or caries.
2. Chipped teeth, fractured cusps or root canal treated tooth.
3. Dental pathology with similar symptoms.
4. Presence of soft tissue pathology
5. Using orthodontic appliances.
6. FPD/RPD which would interfere with evaluation of hypersensitivity.
7. Chronic use of analgesic/anti inflammatory drugs.
8. Long term antibiotic usage prior to surgery.
9. Allergy to any study products.
10. Pregnant or lactating females.
11. History of chronic regurgitation of acids.

Evaluation of sensitivity

Modified Widman periodontal flap surgery was performed quadrant wise in each patient, for standardization. Each patient was recalled the next day (Day-1) and a visual analogue scale (VAS) score for hypersensitivity from 0 to 10 recorded for cold water. 2ml of cold water at 4^0C was delivered from a syringe, 0 being no sensitivity and 10 severe sensitivity.

A Novamin® containing dentifrice was prescribed for brushing twice daily for 7 days. The quantity of toothpaste being peanut size. While brushing the toothpaste should remain in the mouth for atleast 3 minutes. The patient is advised not to eat or drink for 30 mins. Chlorhexidine mouth wash was used only 30 mins after brushing. Analgesic/anti inflammatories were used on the day of surgery. Thereafter only if absolutely needed. The patient was asked to report for evaluation of hypersensitivity without taking analgesics in the morning (Day 1) and the VAS score recorded. On the 8th day (Day 7), during suture removal the VAS score recorded again on a scale of 0 to 10. The same was repeated on the next quadrant for 5% potassium nitrate dentifrice and the VAS score recorded on day 1 and day 7.

Background of study participants

The sample size for the study was 94 quadrants (47 individuals).The mean age of the sample being 39.98yrs. Min: age was 29yrs and max: age 51yrs. Males comprised 44.7% and females 55.3%.

Results

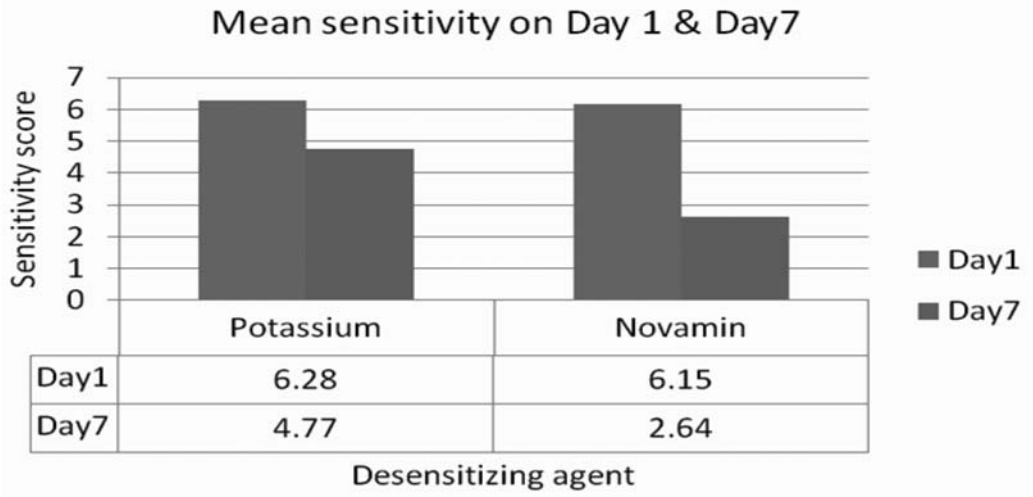
The range of sensitivity on day 1 varied from 3-9 and on day 7 varied from 1-8. The mean sensitivity on day 1 was 6.21 (SD1.70) and on day 7-3.70 (SD1.91). On day 1, 47 quadrants were treated with Novamin® and 47 quadrants with 5% potassium nitrate. The results evaluated on day 7 for both the desensitizing agents. The mean sensitivity on day 1 for Novamin® was 6.15 (SD1.84) and that of 5% potassium nitrate-6.28 (SD1.57). There was no statistically significant difference between the two groups($p>0.1$).

The mean sensitivity on day 7 for Novamin® was 2.64 (SD1.42) and that for 5% potassium nitrate 4.77 (SD1.75). There was a significant difference between the 2 groups($p<0.001$).

The mean difference of sensitivity for Novamin® (day1-day7) was 3.51 (SD1.06), and the mean difference of sensitivity for 5% potassium nitrate (day 1-day7) 1.51 (SD1.06). There was a significant difference in both groups.

Age wise sensitivity on day 1- There was significant difference in sensitivity among different age groups. Max:

Sensitivity score on day 1 and day 7



sensitivity was observed in the age group of 36-45 yrs. The lowest was observed in patients below 36 yrs. This aspect needs further research.

Age wise sensitivity on day 7- There was no significant difference observed between different age groups on day7.

Sex wise sensitivity on day1 and day7- No significant difference observed between males and females on day1 and day7.

Statistical evaluation of the effectiveness of antihypersensitivity agents-

Students t test was done to compare the effectiveness of Novamin® and 5% potassium nitrate dentifrices. Novamin® was found to be 2 times more effective than 5% potassium nitrate. (Confidence interval – 1.95-2.50).

Discussion

Mean sensitivity was significantly lower with Novamin® containing dentifrice than 5% potassium nitrate dentifrice. Benefit of Novamin® containing dentifrice was significantly higher than that of 5% potassium nitrate.

The better results with Novamin® containing dentifrice compared to 5% potassium nitrate dentifrice may be due to[10]

1. Rapid mechanical occlusion of tubules with penetration.
2. Chemical bond to the dentin surface.
3. Release of Na and Ca with a decrease in the rate of nerve impulse transmission.
4. Release of Ca and P for remineralization which produces long term sensitivity reduction.

Conclusion

Apart from the hypersensitivity reduction properties of Novamin®, its anti microbial and anti inflammatory property makes it an ideal choice for post surgical oral hygiene management.

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Crown dilaceration: Endodontic considerations

*** Lakshmi Aravind**

Abstract

Tooth dilacerations may occur anywhere along the extent of the tooth. Dilaceration is a developmental anomaly where there is an abrupt change in the axial inclination between the crown and the root of a tooth. Crown dilacerations have been less commonly reported than root dilacerations. The maxillary central incisors are the teeth most commonly affected followed by the mandibular central and lateral incisors. Trauma and periapical infection of the deciduous predecessor teeth are the most common causes of this anomaly.

Introduction

The term Dilaceration was first used by Tomes in 1848 and is defined as bend in the linear relationship of crown of a tooth to its root.[1] Dilaceration of tooth may involve the root more commonly than the crown. Crown dilacerations has been rather uncommonly reported in literature. Unlike root dilacerations, they do not pose a diagnostic challenge to the dentist, though they do require modifications in the endodontic technique.

Incidence

Crown dilacerations may present itself in an erupted or unerupted tooth. This may involve non-eruption of the affected tooth or prolonged retention of the primary predecessor tooth.[2]

Permanent maxillary central incisors are the most commonly dilacerated teeth followed by the mandibular central and lateral incisors.[3] They occur in maxillary permanent incisors due to close proximity to primary teeth.[5] Dilaceration of primary teeth can also occur. Maxillary incisors commonly incline lingually whereas mandibular incisors usually incline facially.[2]

Etiology

The most widely accepted cause is mechanical trauma to the primary predecessor tooth.[4] The calcified portion of the tooth germ is displaced in such a way that the remainder of the permanent tooth germ forms at an angle to it. The permanent incisors are affected by the intrusion, avulsion or gross displacement of primary incisors. The type and severity of the disturbance is dependent upon the stage of development of permanent teeth, relationship of crown of permanent tooth to roots of primary teeth and direction and degree of force. Dilaceration of primary teeth can occur due to trauma secondary to neonatal laryngoscopy and endotracheal intubation. Matsuoka reported a rare case of crown dilacerations of mandibular first premolar caused by trauma during extraction of precedent primary molar.[6]

An idiopathic developmental disturbance has also been proposed as another possible cause.[7]

Pulpal infections of primary teeth and subsequent periapical infections may also lead to such anomalies. [8]

Diagnosis

Crown dilacerations usually of erupted teeth can be visually observed in the mouth whereas radiographic examination is needed for unerupted teeth.[9] Radiographically, unerupted teeth are seen foreshortened coronally. The patient usually presents needing a cosmetic correction of the dilacerated crown.

The direction of dilacerations have been reported only in the labial/buccal or palatal/lingual plane. Mesial/distal angulations have never been reported. Localized enamel and dentin defects may also be seen. Dilacerated mandibular anteriors are usually nonvital with periapical inflammatory lesions.

Discussion

Crown dilacerations occur due to the traumatic non-axial displacement of the already formed hard tissue portions of the tooth in relation to the developing soft tissue portion. The pathology of crown dilacerated teeth can be explained by the theory of displacement of enamel epithelium and mineralized portion of the tooth in relation to dental papilla & cervical loop. [10]

In cases of palatal inclination, facially the stretched inner enamel epithelium is able to induce differention of new odontoblasts and hence dentin formation is not affected. On the lingual side, the displaced inner

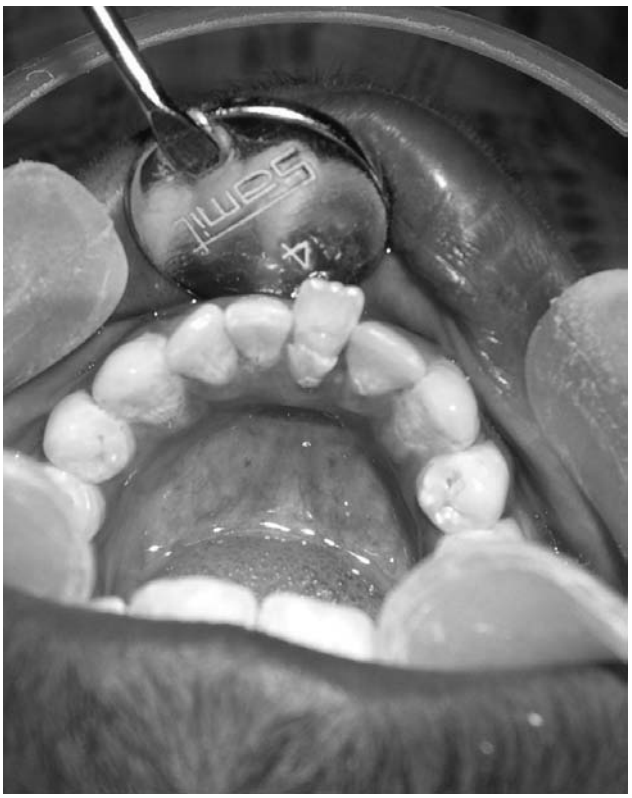

Fig 1. Crown dilaceration in mandibular central incisor

enamel epithelium of ameloblast form a cone of hard tissue which usually projects into the pulp canal.

Pulp necrosis and a peripaical lesion is a common finding probably because the bent portion with defective enamel and dentin acts a nidus for entry for bacteria.[3]

Treatment considerations:

As the teeth usually present with an inflammatory periapical lesion, a multi-visit root canal treatment is usually planned. Access cavity preparation may have to be modified to gain a straight-line access to the teeth. Access will have to be gained from the labial aspect in case of lingually/palatally inclined teeth and from palatal aspect in facially inclined teeth.

Conclusion

A dilacerated tooth may fail to erupt or may sometimes erupt in an abnormal position causing displacement of adjacent teeth. In case of erupted teeth, it is best to institute restorative therapy as soon as the dilacerated area erupts to a level free of gingival. This may help prevent bacterial entry through the defective portions and hence pulpal necrosis.

Crown dilacerated teeth, even though do not carry much of diagnostic difficulties, they may present prognostic challenges which can be overcome by proper diagnosis, endodontic & restorative management.

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Lasers – the cutting edge in endodontics

*** Parvathy V.**

Abstract

Lasers in dentistry offer incredible accuracy, less pain, faster healing and protection. Dentists who make use of dental lasers are competent enough to deliver a diverse category of dentistry than mainstream. Furthermore, patients also prefer receiving treatment from the dental office with professionalism, permanence, knowledge and assurance of safety protocols and the newest techniques. This article focuses on the current and possible future clinical indications, devices, techniques, assessment methods and mechanisms of lasers in endodontics.

Lasers are devices that transform light of various frequencies into a monochromatic radiation in the visible, infrared and ultraviolet regions with all the waves in the phase capable of mobilizing immense heat and power when focused at close range. Ever since the ruby laser was developed by Maiman in 1960, researchers have investigated laser applications in medicine and dentistry. The first laser used in endodontics was reported by Weichman and Johnson in 1971, who attempted to seal the apical foramen by means of carbon dioxide laser. Although this goal was not attained, sufficient and relevant data were obtained to encourage further study. [1,2] Current endodontic applications include:

1. Vital and nonvital diagnosis of dental pulp

❑ *Laser Doppler flowmetry*

Developed by Tenland in 1982 and Holloway in 1983, LDF is based on the changes in red blood cell flux in the pulp tissue, which gives a truer picture regarding pulp vitality. The Doppler shifted laser light, back scattered out of the tooth is detected by a photocell on the tooth surface and processed and an output signal is produced The detected output signal can be fed into an analog printer or to be read from a digital board. HeNe and diode lasers are used for the purpose. [3,4]

Advantages

♦ Useful for vital and nonvital diagnosis of immature traumatized teeth, Noninvasive, Simple to apply and painless, Provides a continuous record

Disadvantages

♦ Impossible to calibrate the readings in absolute units, Output may not be linearly related to blood flow, Difficult to obtain laser reflection from some teeth especially molars

❑ *Heat stimulation by laser*

Pulsed Nd:YAG lasers are commonly used. The pain induced by laser is mild and tolerable than electric pulp testers.

2. Differential diagnosis of pulpitis

❑ *Normal pulp and acute pulpitis*

When normal pulp is stimulated by pulsed Nd:YAG laser at 20W and 200 pulse per sec, 10mm from tooth surface, pain is produced in 20-30 seconds and disappears in couple of seconds after stimulation is stopped. But in acute pulpitis, pain is induced immediately and lasts for more than 30 seconds after stopping the laser stimulation.[1,4]

❑ *Acute serous pulpitis and acute suppurative pulpitis*

If the electric current resistance is greater than 15.1mΩ and patient experiences continuous pain for more than 30seconds, diagnosis is acute serous pulpitis. But if the electric current resistance is less than 15.1mΩ and patient experiences continuous pain for more than 30seconds, diagnosis is acute suppurative pulpitis. [1,4] (Fig.1.)

3. Desensitization of hypersensitive teeth by laser stimulation

Laser stimulation may be applied to tooth acupuncture points or on the mucosal surface corresponding to the root apex. Most of the effect results from morphologic changes produced in dentin and stimulation of central pulp neurons. CO_2, pulsed Nd:YAG, HeNe and diode lasers (1W, 20pps, less than 0.1sec) may be used.[5]

4. Indirect pulp capping

CO_2, pulsed Nd:YAG (2W, 20pps, less than 1sec) are used.[1,2]

5. Direct pulp capping

Lasers aid in disinfection, sterilization, carbonization and stimulation of dental pulp cells.[1,2] Moritz et al in 1998 have found 89% success rate.

6. Vital pulp amputation

Laser aids in hemostasis and cell stimulation after

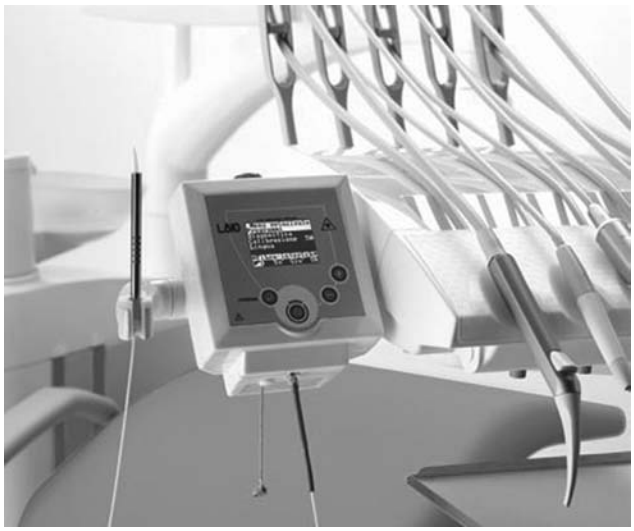

Fig 1 Laser unit for RCT

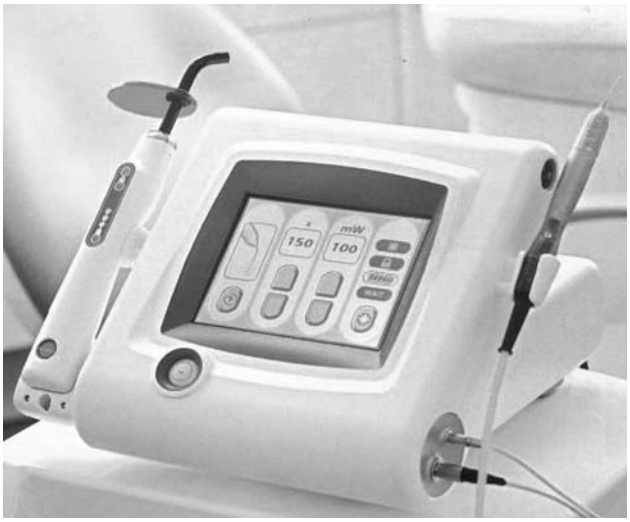

Fig 2 Pad unit

pulp amputation with an excavator or bur. CO_2, pulsed Nd:YAG, HeNe and diode lasers may be used[1,2]

7. Access cavity preparation and enlargement of the root canal orifice

Indications

- Vital extirpation of infected root canals, Canals in which Peeso and Gates Glidden drills cannot be inserted into the tooth, Difficulty in finding root canal orifices

Er, Cr:YSGG lasers at 5W and 6Hz are used. Care must be taken to avoid perforation and ledge formation. [1,6,7]

8. Pulpotomy and root canal wall preparation

Er:YAG lasers at 2W and 8Hz have been produced by Kavo to prepare root canals. The laser tip must slide gently from the apical portion to the coronal portion, while pressing the laser tip to the root canal wall under water spray. When the laser fibre is unable to be inserted into root canals, laser treatment should be carried out after performing the usual preparation using reamers and files. Various studies have shown that the smear layer was removed completely and that the dentinal tubules were opened using this technique. [6,7]

9. For removal of pulp remnants and debris at the apical foramen

The pulsed Nd:YAG laser (2W,20pps,1sec) was used successfully by Koba et al in 1998. [7,8]

10. Root canal irrigation

Pulsed Nd:YAG laser, Er, Er:YAG, Cr:YSGG laser devices produce cavitation effects in root canals similar to that of ultrasonic irrigator (Takeda et al,1999), but of a weak nature [7,8]

11. Sterilization or disinfection of infected root canals[7,10]

CO_2, pulsed Nd:YAG, Er:YAG and diode lasers are used. Rooney et al (1994) reported sterilization rates of 80-90%. However, application to extremely curved and narrow infected root canals is difficult.

The photoactivated disinfection (PAD) process is based on the principle that certain photoactive agents such as tolonium chloride may be taken up by bacteria preferentially. If these bacteria are then irradiated with light of a specific wavelength (diode laser delivered via a fibreoptic cable to a disposable handpiece), the photoactive agent produces singlet oxygen, a protoplasmic poison, killing the bacteria, whilst not affecting the surrounding tissues. (Fig.2). Further evidence to date indicates that the bacteria are not able to produce resistant strains to the photoactive agent. PAD appears promising in vital pulp treatment and in periradicular surgery. [4,9]

12. Strengthening and sterilization of the root canal wall using silver ammonium solution and laser

CO_2, pulsed Nd:YAG, Er:YAG, argon and diode lasers are used to prevent tendency of pulpless teeth to fracture. Although a few basic research studies have been published, there have been no reports concerning clinical assessment. [9]

13. Closure of apical foramina

By combining light curable composite resin and argon laser or combining sectional gutta-percha and a pulsed Nd:YAG laser, it was relatively easy to close the apical root canal. Mor et al in 1995 evaluated efficacy of excimer lasers and found promising results.[2,8]

14.Laser treatment under a stereomicroscope and fiberscope

By combining these instruments the dentist can remove debris, pulp remnants, pulp polyps, fractured instruments and root canal filling materials. Also, the

dentist can inspect the prepared wall for apical seal, perforations and dentin bridge. [1,8]

15. Sedative and anti-inflammatory treatment of trigeminal neuralgia

The mechanism of anti-inflammatory effects is thought to be the reduction of swelling and pain that is induced by dehydration of inflamed tissues and decomposition of certain pain producing substances and inflammatory factors as well as pain reduction at the level of central neurons. [1,2]

16. Prevention of microleakage of retrograde filling

Yamasaki et al in 1999 confirmed a decrease in microleakage invitro after using lasers in combination with 38% silver ammonium solution at apicoectomy. [10,11]

17. Apicoectomy, retrograde endodontic apical cavity preparation and periapical curettage

CO_2, Nd:YAG, Er, Cr:YSGG and Er:YAG lasers have been used in cases with continuing clinical symptoms, root canals with fractured instruments, sinus tracts with pus discharge not responding to standard endodontic treatment.[2,10,11]

18. Root canal filling using gutta-percha or resin and laser

Arnic et al in 1995 evaluated root canal filling using sectional gutta-percha and a pulsed Nd:YAG laser. At present, this technique is not practical. Although a method combining light curable composite resin and argon laser is in the literature, proper application of this method requires further research. [1,2]

19. Removal of temporary cavity sealing materials, root canal sealing materials and fractured instruments in root canals

Nd:YAG, Er, Cr:YSGG and Er:YAG lasers have been evaluated for the purpose. However, in fine and strongly curved canals the laser tip may perforate the root canal wall. [2,11]

20. Treatment of periapical lesions and sinus tracts

CO_2, pulsed Nd:YAG lasers have been used for cases where apicoectomy or standard endodontic treatment cannot be performed. The fibre tip must be inserted into the tract and drawn slowly from the root apex to the exit through the sinus tract. This treatment is generally performed 3-4 times during one visit. CO_2 laser at 1-2W and under air cooling or local anaesthesia are performed once or twice a week until the sinus tract disappears.[4]

Conclusion

In the field of endodontics, laser treatment in endorsing dental care is reaching new heights. Lasers in current form are expensive, generate heat and are low in efficiency for bulk removal of tooth tissue. However, lasers offer precision cutting which may be developed further in the future. Nevertheless, dentists must understand the information and strategy concerning laser safety prior to activating any laser within the practice.

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Self adjusting files: the new adaptive technology

* Sheila George

Abstract

Introduction of the self adjusting files which posess the adaptive endodontic technology, may result in a major breakthrough in endodontics. It adapts itself to the cross section of the root canal, rather than imposing a circular cross section on every canal no matter what its shape as seen with other rotary file systems. Hence, the original cross section of the root canal is respected both longitudinally and in cross section. This article gives a brief insight into these files and their advantages over other rotary nickel- titanium file systems.

Introduction

Cleaning and shaping of the root canal system entails removal of all tissue debris from the root canal space while removing the inner layers of root canal dentin.[1] The introduction of the 'memory' alloy paved the way for a new era in endodontics. Rotary root canal systems achieve the primary goals of cleaning and shaping easily in relatively straight and narrow canals with a round cross section. However the goal is not easily attainable in flat oval shaped and curved root canals.[2] In such cases fins that are underprepared maybe left behind which fail to be adequately sealed even with use of warm gutta percha obturation methods.

The latest advent in the field rotary nickel-titanium file systems is the 'self adjusting file'. SAF was introduced by Tel Aviv university and Re-Dent Nova. Inc of Israel. They were introduced with the aim of achieving thorough cleaning and shaping of flat, oval shaped root canals and curved canals.[3]

Features of SAF:

- Single file

- Hollow, compressible, thin-walled, pointed cylinder 1.5 or 2.0mm in diameter composed of 120 microm thick Ni-Ti lattice

- Continous irrigation provided by means of a special irrigation device

- Light abrasive surface of the lattice threads, which remove dentin

Clinical technique

SAF is available in 3 standard lengths of 21, 25 and 31mm. A single instrument achieves 3 dimensional cleaning and shaping along with irrigation. The file is used with transline vibrating handpieces with 3000-5000 vibrations per minute.[3] Dentin removal is achieved by the abrasive surface of the lattice and vibrating movement along with intimate contact of the file along the entire circumference and length of the canal. SAF file can be elastically compressed substantially to the extent that it assumes dimensions resembling those of an ISO size 20 K file. This is possible because of the special design of the file and it represents the high cumulative elasticity of each of the arches that connects the longitudinal beams. When initially compressed, the SAF applies a circumferential force that is applied to the canal walls. This results from its high elasticity and tendency to reassume its initial dimensions. This force combined with the file's surface abrasiveness and the in-and-out movement may allow for dentin removal from the canal walls.[4]

Advantages

1. Adapts itself to the three dimensional anatomy of the root canals
2. Single file
3. Removes a uniform layer of dentin from its walls
4. Prevents apical transportation and zipping
5. Effective replacement of irrigant in the apical part of the canal with no significant positive pressure ensures minimal postoperative discomfort
6. Highly flexible, pliable and durable
7. Less chances of instrument separation

SAF has been approved for clinical use in Israel and Europe and it has already been used in various clinical situations. The quality of root canals prepared with SAF showed that the canal surfaces unaffected by the canal preparation was significantly less when compared to other rotary Ni-Ti systems. The files produce a smear layer, as dentin removal is accomplished by dentinal 'grinding'. A dentin surface free of smear layer is however achieved by an irrigation protocol which involves alternative administration of 3% sodium hypochlorite

Fig 1 Self adjusting file

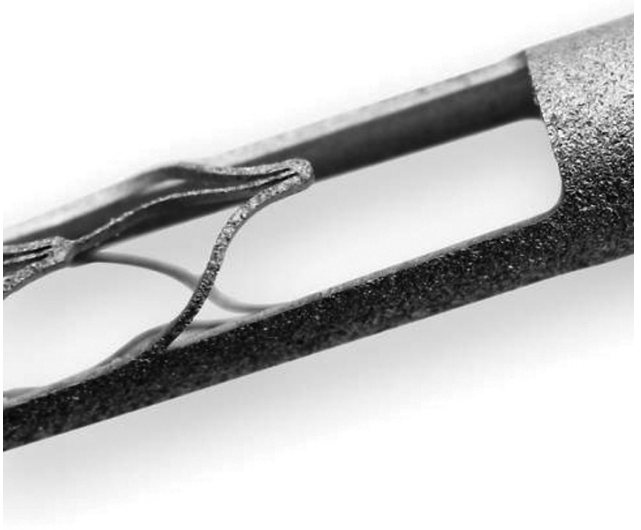

Fig 2 Hollow file with a 120microm thick nickel-titanium lattice and abrasive surface

and 17% EDTA.[5] The irrigating fluids in the apical part of the canal are effectively replaced by the SAF file. This is accomplished by the vibrating motion of the file's delicate mesh within the fluid.[5]

SAF operates in a totally different manner than syringe and needle irrigation. The hollow file is operated with continous irrigation provided by a special device. The chosen irrigation fluid enters the file through a free-rotating hub and is continuously replaced throughout the procedure, thus providing a fresh, fully active supply of solution. In addition to effectively replacing the irrigant from the apical part of the root canal and the activation of the irrigant through the creation of turbulence, SAF also induces a scrubbing action on the canal walls that result in an exceptionally clean surface, even in the cul-de-sac portion of the canal.

It has been reported that the radiographic images of canals obturated after canal preparation with SAF were the same as that prepared by other file systems.[6] The clinical outcome of such canals may however be more positive due to the many advantages of SAF over the currently available rotary Ni-Ti systems.

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Propolis -an extra-alveolar storage media for tooth autotransplants in Orthodontics

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Abstract

A wide variety of storage media have been proposed in the literature for tooth transplants during the time in which the new socket is being prepared. The storage medium is expected to maintain or improve the vitality of the cells of the periodontal membrane and cementum, since it is generally accepted that a vital periodontal ligament is essential for the long-term survival of a transplant. Propolis is one such storage media. Its different uses in dentistry have also been explored. Propolis has anti-bacterial, anti-viral, anti-fungal and anti inflammatory effects which makes it a suitable storage media for tooth transplants in orthodontics. This article reviews the use of Propolis as a storage media for autotransplantation.

Introduction

Tooth autotransplantation is the process in which a tooth, usually impacted, is surgically transferred to correct position, or to replace another tooth, in the same alveolus.[1] This involves removing the tooth, creating a new socket in the same alveolar bone and repositioning the tooth. The tooth is stored in an appropriate storage medium to preserve the periodontal membrane and cementum of the root during the extra-alveolar period when the new socket is being prepared. The maintenance of the vitality of the cells of the periodontal ligament and cementum is essential for the long-term success of a transplant. The tooth is surgically transferred from its initial position, without traumatizing the cells of the periodontal ligaments and cementum, into a new socket.

The third mandibular molars and the maxillary canines are the two most frequently misplaced or impacted teeth in the human dentition. The same are also frequently autotransplanted.[2,3,4,5]

Moss[6] gave the reasons for the frequent autotransplantation of maxillary canines. The upper canine is the most frequently misplaced tooth in the anterior part of the mouth. Orthodontic alignment of the tooth can be difficult and protracted. According to Andreasen et al[7], tooth autotransplantation has recently become a method of treating orthodontic problems. Patients are often unaware that the canine is misplaced until they are in their late teens and early twenties, and at this age, orthodontic treatment is less acceptable to many patients on aesthetic and social grounds.

An impacted or developing third molar may also be autotransplanted to the position of a first or second molar indicated for extraction.

Composition, properties and uses of propolis in dentistry

Propolis is a Greek word meaning "defender of the city". It is the glue that honey bees use to seal their hives. It is composed of resin (55%), essential oils and wax (30%) mixed with bee glue "the salivary secretions of bees" and pollen (5%) and other constituents (10%) which are amino acids, minerals, ethanol (alcohol), vitamins A, B complex, E and the highly active bio-chemical substance known as bioflavenoid. It is a prime source of histamine and serotonin being substances needed to help the body cope with allergies. Propolis has anti-bacterial, anti-viral, anti-fungal and anti inflammatory effects. It is available in the world markets in different forms as capsules, lozenges, tincture and cream in Europe and America. It is already available in Russia as toothpaste. Further, research is being carried out at Oxford University, on the benefits of Propolis.[8]

Propolis in dentistry is used for repair of surgical wounds, treatment of root canal and periodontitis, application of Propolis to dental sockets and skin wounds, direct and indirect dental pulp capping and effect on dentinal hypersensitivity.

Propolis as a storage media

Martin and Pileggi[9] investigated the potential of a new storage medium, Propolis, in maintaining viable periodontal ligament (PDL) cells on simulated avulsed teeth. The experimental teeth were stored dry for 30 minutes and then immersed in one of the five media (Hank's balanced salt solution (HBSS), milk, saline, Propolis 50%, and Propolis 100%) for 45 minutes. The teeth were then treated with dispase grade II and

collagenase for 30 minutes. The number of viable PDL cells were counted with a haemocytometer and analyzed. It was found that both Propolis groups kept significantly more PDL cells viable compared to milk, saline or HBSS. It was concluded that Propolis appeared to be a better alternative to HBSS, milk or saline in terms of maintaining PDL cell viability after avulsion and storage.

Enhancement of pulp healing by propolis from the Brazilian region[10] has been demonstrated in the reparative process of pulpal tissue with dentinal bridge formation. It has been shown to be biocompatible with the periodontal ligament cells and to be a potential storage media by Martin MP, Pileggi R et al.[11-13] In addition, Koo H et al has demonstrated significant antibacterial activity against oral pathogens, including E. faecalis.[14-15]

Because osteoclastogenesis and bone resorption are associated with inflammation, propolis was tested to detect if it had an effect on the formation and activation of osteoclasts-like cells by making use of well characterized invitro culture system. A report by Martin MP, Pileggi R. suggests that propolis inhibits osteoclastogenesis and osteoclast activation in tissue culture, Thus showing the direct actions of propolis on osteoclasts.[16] So further studies need to be undertaken to investigate if it can be used to prevent root resorption after autotransplantation.

Conclusion

As propolis could be beneficial to avulsed and replanted teeth, further research is needed to determine a standard formulation for therapeutic use. To date the trauma literature has not put forth a storage media for the avulsed tooth that not only keeps the PDL cells alive but also has antibacterial and anti-inflammatory properties. Along with propolis potential to keep PDL cells viable, perhaps future research can demonstrate how its antibacterial and anti-inflammatory properties may be effective in preventing the resorptive sequelae that often lead to loss of tooth post replantation.

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Genetic technology in the management of periodontal disease: The new frontier

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Along with dental caries, periodontal disease has been considered as one of the most important global oral health burdens. Chronic periodontitis, formerly known as 'adult periodontitis' is the most prevalent form of the disease. Even though moderate periodontitis affects a majority of adults, only some 5-20% of any population progresses to severe, destructive forms of periodontal disease. Another form of periodontal disease distinguished on the basis of its rapid rate of progression, known as aggressive periodontitis is observed in otherwise healthy adolescents and young adults, with a prevalence of less than 1%.

Although bacteria are essential for the initiation of periodontitis, the quantity of microbial deposits alone has not been sufficient to explain the differences in the disease severity that are routinely observed among individuals. The host system, which is normally protective, causes tissue damage when the balance between the antimicrobial defence system and bacteria is disrupted. This host bacterial interaction is influenced by various environmental factors such as poor oral hygiene, tobacco use, malnutrition, excessive alcohol consumption, stress, hormonal factors, diabetes mellitus and certain other systemic conditions.

While microbial and environmental factors initiate and modulate periodontal disease, individuals are known to respond differently to similar environmental challenges, and this differential response is influenced by the individual's genetic profile. Studies in monozygotic and dizygotic twins have indicated that a substantial portion of this inter-individual variability in periodontal parameters may be attributable to genetic factors. However it is not genes alone but the interplay of genetic and environmental factors that determines the disease phenotype. Genetic factors modulate how individuals interact with many environmental factors, e.g. the local microflora, which serves as a trigger for the host response. A relatively recent focus in periodontology has been to quantify the genetic risk and identify specific genetic variants that determine disease susceptibility.

Role of Genetic Variants in Determining Periodontal Disease Susceptibility

The role of host genes in the etiology and pathogenesis of periodontal diseases is just beginning to be understood. Severe forms of periodontitis have been observed in individuals with primary or secondary neutrophil disorders. Specific mutations have been identified to define the genetic basis of these various syndromic forms of periodontitis for example; the Cathepsin V gene defect in Papillon Lefevre syndrome and the ?-2 integrin chain gene in case of Leucocyte Adhesion Deficiency syndrome. These diseases follow a simple and predictable classic Mendelian mode of inheritance (autosomal dominant, recessive or X-linked). The underlying genetic mutations are rare alleles that dramatically disrupt the expression or function of a gene product and therefore may be considered deterministic of the disease.

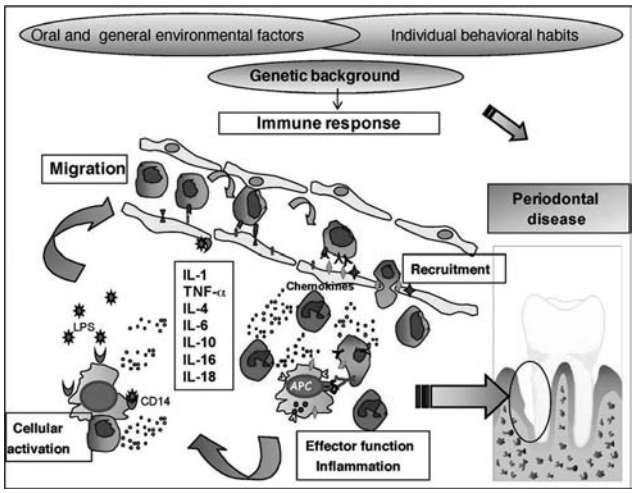
These conditions are however rare and do not characterize the common forms of periodontitis which are more likely genetically complex diseases which are the result of the interaction of alleles at multiple gene loci. The genetic aberrations involved in these disease models are involved in more subtle genetic changes that may slightly alter the expression or function of a gene product. Such genetic variants which occur with a population prevalence of greater than 1% are termed genetic polymorphisms. A single functional genetic polymorphism is not sufficient to cause the disease, and therefore by itself is not deterministic of the disease. Hence the disease associated allele may present in a significant proportion of the unaffected general population as well.

Genetic studies including segregation and linkage analysis indicate that there are multiple different genetic forms of aggressive periodontitis, however it is currently unclear how many genes may be involved in these non-syndromic forms of the disease. While genes of major effect appear etiologic in aggressive periodontitis and some syndromic forms of periodontitis, there is also evidence for smaller contributions by genes that may alter the periodontal disease manifestation.

In case of chronic periodontitis, evidence for a genetic component in determining disease susceptibility comes primarily from twin studies. These investigations have suggested that approximately half of the inter-individual variability in probing depth and clinical attachment loss could be attributed to genetic factors. Several genetic loci interact with each other to produce an underlying susceptibility, which in turn interacts with environmental factors to ultimately determine the periodontal status.

Genetic Study Designs in Periodontitis

A number of statistical approaches have been used to determine the genetic components involved in



(From: Cytokines and Growth Factor Reviews 20, 2009 223-232)

Fig.1. Interplay of several factors in the pathogenesis of periodontal disease. Cytokine gene polymorphisms affect the outcome of the inflammatory response to the bacterial challenge.

periodontal diseases. Twin study designs and linkage analysis have been used to test the hypothesis regarding disease heritability and mode of transmission, but they do not identify the specific genes involved. In case of syndromic forms of aggressive periodontitis, in which genes of major effect have been implicated, (i.e. Mendelian single gene disorders) gene mapping approaches have been used. These approaches rely on the co-segregation of an inherited disorder with a genetic marker of known chromosomal location.

In contrast to the Mendelian disorders, association methods are more frequently applied to complex traits and they may be more powerful in identifying etiologic genes for complex traits than the linkage approaches. In association analysis, one compares the allele frequencies of a genetic marker or candidate gene between groups of affected individuals versus controls. If the allele frequencies differ significantly between the cases and controls, then a specific allele at the marker or candidate locus is said to be associated with the disease at the population level.

The distribution and frequency of the investigated gene polymorphisms may vary considerably among different population cohorts, particularly those belonging to differing racial and ethnic origins. Hence, gene association studies may require the investigation of large homogenous cohorts and data obtained from one study may not be readily generalized to other patient cohorts. In addition the 'candidate gene approach' carries the inherent risk of over-looking other genes involved in the regulation of inflammation and consequently missing a genetic loci that could be strongly associated with disease risk.

Functional analysis, considering the carriage of specific combination of alleles within a given locus (haplotype analysis) and among various genes (gene-gene interaction) are encouraged. In the pursuit of better genetic diagnostic tests in the future for chronic and aggressive forms of periodontitis, we must be vigilant to use biologically plausible arguments and carefully avoid bias and misinterpretation of genetic associations with disease.

Application of Genetic Research to Clinical Practice

Elucidation of the genetic basis of periodontitis would permit a better understanding of the disease etiology, allowing improved classification, diagnosis and treatment. Albeit, the current practical clinical utility of genetic knowledge in periodontics is rather limited.

In cases of syndromic forms of periodontitis (Mendelian conditions), it is often possible to develop a diagnostic test to identify individuals who carry the disease-causing mutation in the responsible gene. Depending upon the mode of transmission, it is then also possible to make fairly specific predictions of the probability of the mutant gene being transmitted to the offspring. Currently, it is possible to perform genetic testing to identify individuals carrying gene mutations responsible for several syndromic forms of periodontitis associated with Leucocyte adhesion deficiency (LAD) types 1 and 2, Papillon Lefevre syndrome, Haim Munk syndrome, Chediak- Higashi syndrome and some forms of Ehlers Danlos syndrome.

There are numerous challenges in developing a clinically relevant diagnostic or screening test for chronic periodontitis since it is a complex genetic disease. In such a model, a single gene allele may contribute to the disease susceptibility, but it may not make a large enough contribution to provide clinical utility as a genetic test. Hence studies have focussed on evaluating various genetic variants (polymorphisms) occurring in the human genome. A number of genetic polymorphisms have been studied for an association with chronic periodontitis including several cytokines like IL-1, IL-6, IL-10, where the most work has been done; the Vitamin D receptor; the Fc? receptor; tumor necrosis factor-? and several Human Leucocyte Antigen variants.

While many genetic polymorphisms have been evaluated and association with periodontal disease have been established, none have proven to be strongly predictive as diagnostic or prognostic markers to identify patients within the general population who are at risk. With the development of newer technologies such as genome-wide "SNP- Chips" it is likely to be possible to carry out more systematic studies to identify gene loci associated with a risk of disease in the future.

Commercially Available Genetic Susceptibility Test for Periodontitis

In a scientific breakthrough, the PST (Periodontitis Susceptibility Trait) test was developed based on the specific variation in IL-1 genes to identify patients genetically predisposed to severe periodontal breakdown. It tests for the simultaneous presence of allele 2 at nucleotide position -889 in the IL-1? gene and position +3954 in the IL-1? genes, referred to as the 'composite genotype'. The presence of the genotype

Table I. *Summary of syndromic forms of Periodontitis due to a genetic alteration at a single gene locus*

Condition	*Biochemical ? tissue defect*	*Inheritance*
Papillon-Lefe`vre syndrome	Cathepsin C	Autosomal recessive
Haim-Munk syndrome	Cathepsin C	Autosomal recessive
Ehlers-Danlos syndrome type IV	Collagen	Autosomal dominant
Cyclic neutropenia	Neutrophil elastase	Autosomal dominant
Chediak-Higashi syndrome	Lysosomal trafficking regulator gene	Autosomal recessive
Leukocyte adhesion deficiency type II	Glucose diphosphatefucose transporter-1	Autosomal recessive
Leukocyte adhesion deficiency type I	Leukocyte chain adhesion molecule CD18	Autosomal recessive

Table II. *Summary of candidate genes, and the corresponding encoded protein which have been investigated as putative risk factors for periodontitis*

GENE	*CODED PROTEIN*
ACE	Angiotensin-converting enzyme
CCR5	Chemokine receptor-5
CD14	CD-14
ER2	Estrogen receptor-2
ET1	Endothelin-1
FBR	Fibrinogen
Fc?RIIa, Fc?RIIb	Fc ? receptor IIa, Fc ? receptor IIb
Fc?RIIIa, Fc?RIIIb	Fc ? receptor IIIa, Fc ? receptor IIIb
IFNGR1	Interferon ? receptor-1
IL1A	Interleukin-1?
IL1B	Interleukin-1?
IL1RN	Interleukin-1 receptor antagonist
IL2, IL4, IL6, IL10	Interleukin-2, Interleukin-4, Interleukin-6, Interleukin-10
MMP1, MMP3, MMP9	Matrix metalloproteinase-1,Matrix metalloproteinase-3 Matrix metalloproteinase-9
MPO	Myeloperoxidase
PAI1	Plasminogen-activator-inhibitor-1
RAGE	Receptor for advanced glycation end products
TGFB	Transforming growth factor-?
TIMP2	Tissue inhibitor of matrix metalloproteinase-2
TLR2, TLR4	Toll-like receptor-2, Toll-like receptor-4
TNFA	Tumor necrosis factor- ?
TNFR2	Tumor necrosis factor receptor-2
VDR	Vitamin D receptor

is associated with higher levels of IL-1 production and a significant increase in the risk for generalized periodontitis in non-smokers. Subsequently the test was modified to assess for the IL-1 ? +4845 polymorphism because it is technically easier to identify and it is reported to be 100% concordant with IL-1 ?-889 locus and as a result of the nomenclature changes in genetic numbering systems, the IL-1 ? +3954 locus has been re- numbered as the IL-1 ?+3953 locus.

While interesting relationships have been reported between specific genetic polymorphisms and periodontal diseases, the results are equivocal or restricted to specific patient categories, suggesting the need for further research to provide additional insight into their clinical utility. Although certain studies are encouraging, there is currently an insufficient body of evidence to support a modification of treatment protocols for chronic periodontitis based on IL-1 genotype testing.

Conclusion

Knowledge of specific genetic risk factors could enable clinicians to direct environmentally based prevention and treatment strategies to individuals who are most susceptible to the disease. Subjects presenting with a genetic risk factor could be regularly monitored in an appropriate recall and maintenance programme that could result in a decrease in the tooth mortality. Thus it is likely that with increased understanding of the exact nature of the association of such cytokine gene polymorphisms with periodontitis, genetic tests will be developed in the future with a multitude of implications in diagnosis, prevention and treatment of periodontal conditions.

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The 3D Revolution in Endodontic Imaging

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Abstract

The ability to asses an area of interest in three dimensions might benefit both novice and experienced clinicians alike. The advantages of three dimensional imaging includes increased accuracy, higher resolution, scan-time reduction and dose reduction. Specific endodontic applications of three dimensional imaging are being identified as the technology becomes more prevalent. It has a great potential to become a valuable tool in the modern endodontic practice. The contemporary three dimensional imaging techniques offer an accurate diagnostic method for use with high resolution images, which can reduce the incidence of false negative diagnosis and can minimize observer interference. The objective of this article is to briefly display the various three dimensional imaging techniques that are being used currently to enhance the success of endodontic treatment.

Successful endodontic treatment depends on the proper cleaning, shaping and obturation of the pulp space system. A thorough knowledge of pulp space anatomy is essential to achieve this goal. The inability to detect, debride and obdurate all portals of exits is a major cause of endodontic failure.

Radiographs are two dimensional representations of three dimensional objects, so it is impossible to reflect accurately the anatomy and morphology of the teeth. Three dimensional imaging can overcome the limitations of two dimensional imaging techniques by producing images of high diagnostic quality. Consequently three dimensional images enable the visualization of the anatomic complexity, disturbances in the typical morphology, presence of material in the pulp space, and progression, regression and maintenance of apical periodontitis.

The various Endodontic applications of three dimensional imaging include:

- Differentiation of pathosis from normal anatomy
- Relationships with important anatomical structures
- Aiding management of aberrant pulpal anatomy
- External & Internal resorption
- Lateral root perforation by a post
- Accessory/ Lateral canal identification
- Root Fractures
- Surgical management of fractured instrument
- Surgical Endodontics
- Aiding surgical Endodontic planning
- Dental Trauma

The different three dimensional imaging techniques that have been used currently are

- Cone Beam Computed Tomography
- Spiral Computed Tomography
- Micro Computed Tomography
- Tuned aperture Computed Tomography
- Peripheral Quantitative Computed Tomography
- Optical Coherence Tomography

Cone beam computed tomography

Cone Beam Computed Tomography has become available for dental offices because of the reduced costs and dimension. Unlike conventional CT scans, they have a reduced acquisition time and use lower irradiation doses. Their field of view is limited, but the spatial resolution is very good in all planes.. These devices give the dental surgeon, high quality 3D diagnostic images of the maxillofacial region and from the acquired data. An advantage of CBCT is that the images can be studied by using different representations (multiplanar reformation, 3D surface rendering)

They can be rotated in any spatial plane without superposition of the anatomic structures. Many dental disciplines exploit the potential of CBCT for diagnosis, decisions on therapy, and surgical preparation. At present, however, there is no application dedicated to endodontics and aimed at exploring the pulp space system qualitatively and quantitatively.[1,2,3,4]

Cone-beam computed tomography (CBCT) uses a cone-shaped beam instead of the fan-shaped one used by regular CT scanners (Fig. 1)

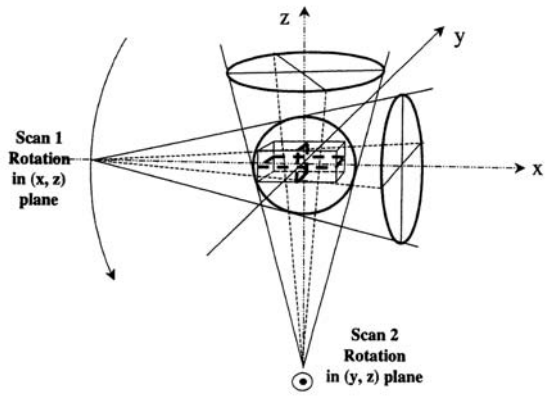

Fig 1

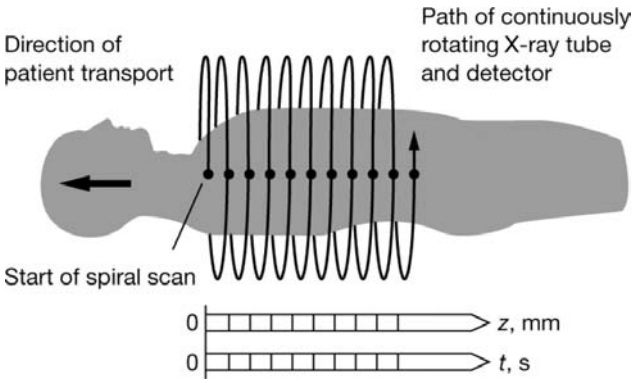

Fig 2

Spiral computed tomography

Spiral computed tomography is a type of three dimensional computed tomography (CT) in which the source (usually of x-rays) describes a helical trajectory (Fig. 2) relative to the object while a two dimensional array of detectors measures the transmitted radiation on part of a cone of rays emanating from the source. In practical helical x-ray CT machines, the source and array of detectors are mounted on a rotating gantry while the patient is moved axially at a uniform rate. Earlier x-ray CT scanners imaged one slice at a time by rotating source and one dimensional array of detectors while the patient remained static. The helical scan method reduces the x-ray dose to the patient required for a given resolution while scanning more quickly. This is however at the cost of greater mathematical complexity in the reconstruction of the image from the measurements.[3,5]

Since its invention by Kalender in the 1980s, helical scan CT machines have steadily increased the number of rows of detectors (slices) they deploy. The prototype 16 multi-slice scanner was introduced in 2001 and in 2004, 64 multislice scanners are on the market. These can produce an image in less than a second and thus can obtain images of the heart and its blood vessels (coronary vessels) as if frozen in time.

Spiral CT, although limited in function, can substitute for CBCT in some fields of dentistry and is more readily available than CBCT. Therefore, when CBCT is not available, spiral CT could be an alternative.

Micro CT

In recent years micro–computed tomography (micro-CT) has proved to be a valuable tool for evaluating the morphologic changes in the canal shape before and after instrumentation. Not only a cross-sectional examination of the root but also the 3-dimensional (3D) configuration of the canal might be evaluated at high resolution. Other advantages of micro-CT technique include little or no specimen preparation required and the nondestructive nature of the process.[6,8]

In contrast to the two dimensional radiographic analyses, micro-computed tomography (microCT) coupled with mathematical modeling is capable of the detailed three-dimensional analysis of the pulp space system. It has been found that microCT accurately reproduced internal and external tooth morphology without tooth destruction, and demonstrated surface and volume changes after cleaning and shaping and obturation in extracted maxillary molars.

Tuned aperture computed tomography

Tuned-aperture computed tomography (TACT) is a relatively new type of imaging that allows the operator to view an object whilst limiting the superimposition of overlying anatomic structures. It has been proven to be an effective diagnostic tool in the evaluation of primary dental caries, simulated recurrent dental caries, and osseous defects. By the utilization of specialized software (TACT Workbench™, Verity Software, Winston Salem, NC, USA) the TACT system can transform multiple images taken at random angles into a three-dimensional data set that can be viewed in 'slices' similar to a CT scan. In short, a digital image is constructed by indexing randomly angled views to a fuducial marker, thereby producing a tomosynthetic 'slice' which can be manipulated to give the most information.

The object of interest does not have to be placed in a certain geometric fixed position whilst images are obtained. The angular disparity of the digital images that are taken can vary widely from patient to patient depending on the specific diagnostic task, the area to be imaged, and the size of the detector. Furthermore, as compared to the CT scan, radiation for the patient using TACT is usually no more than using conventional

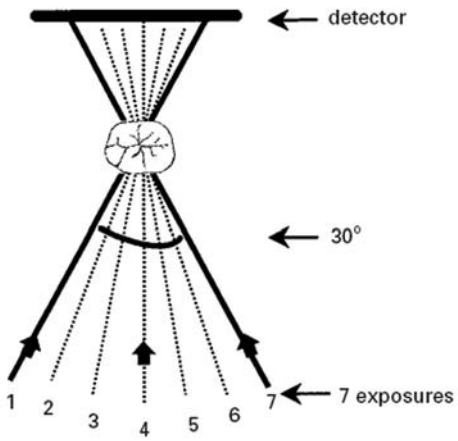

Fig 3: Diagram showing the imaging geometry for TACT

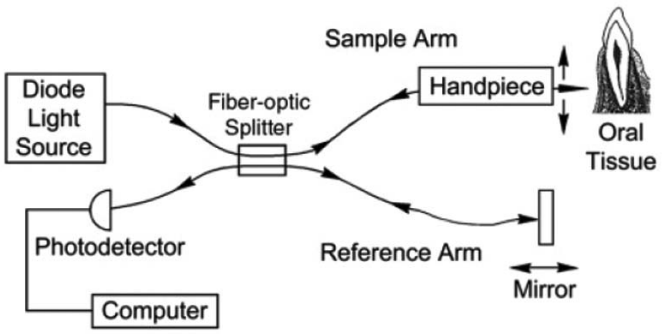

Fig 4. Schematic of Dental OCT

film. The acquisition of the 8–10 images are usually more than sufficient to reconstruct TACT image for most diagnostic tasks. This is roughly equivalent to the amount of radiation received for two D-speed periapical radiographs or less depending on the digital system employed.[8,9] (Fig 3)

Peripheral quantitative CT

In medicine, peripheral quantitative computed tomography, commonly abbreviated pQCT, is a type of quantitative computed tomography (QCT), used for making measurements of the bone mineral density (BMD) in a peripheral part of the body. It is useful for measuring bone strength. pQCT scanning allowed 3D reconstruction of the pulp space anatomy and the assessment of the extent of canal enlargement during pulp space instrumentation. pQCT shows promise for following qualitative and quantitative analysis of endodontic procedures.[10]

Optical coherence tomography

Optical coherence tomography, or OCT, is a new diagnostic imaging technique that has many potential dental applications. OCT, creates cross-sectional images of biological structures using differences in the reflection of light. This technique uses broad-band, near-infrared light sources with considerable penetration into tissue, yet it has no known detrimental biological effect. Microstructural tissue detail is revealed by differentiating between scattered and transmitted, or reflected, photons. OCT was first proposed for use as a biological imaging system in 1991 by Huang and colleagues. Because of their collaborative work, OCT imaging now is being used in clinical practice in ophthalmology.[11]

Dental OCT system consists of a computer, compact diode light source, photodetector with associated electronics and handpiece that scans a fiber-optic cable over the oral tissues. The system uses a white light fiber-optic Michelson interferometer connected to a handpiece that moves the sample arm linearly to create a tomographic scan. Light from the low-coherence diode is separated by a fiber-optic splitter into sample and reference arms of the interferometer. Reflections from the reference mirror and backscattered light from the tissue are recombined at the splitter and transmitted to the photodetector. An interference signal is detected when the pathlength of light reflected from the tissue and the reference mirror is within the coherence length of the source. Because the position of the reference mirror is known, the location within the tissue of the reflected signal can be precisely determined. A single interferometric signal measured at a specific point on the tissue gives the reflective boundary along the axis of the beam. The locations of reflected signals correspond to their axial position, while the magnitude of the signal is determined by the unique scattering characteristics of a particular tissue. Signals, therefore, are relatively high at tissue interfaces. Signal amplitudes are assigned a gray scale, or false color, value in the computer and are displayed in a linear array. These amplitude differences create a range of contrast that is characteristic of the tissue interactions with the light photons. As the handpiece scans the light across a region of clinical interest, axial signals are serially displayed. The final OCT image is a composite of many axial signal arrays in other words, the OCT image is a two-dimensional representation of the optical reflections of tissue in cross-section. (Fig 3)

Conclusion

Three-dimensional imaging will continue to be used extensively as sensor characteristics improve and more advanced software is introduced. As bit-depth and spatial resolution of images increase, 3D imaging will find more applications in endodontics. TACT is currently a research tool but holds promise of delivering a reliable imaging modality. More studies are still in order using high-resolution sensors for basis image capture, for

diagnostic tasks in endodontics. CBCT or VCT provides a significantly faster image acquisition and reconstruction scheme, but the resolution is still inferior to that achieved by TACT. CBCT will continue to be explored for more applications in endodontics. The advent of 3D imaging has provided the endodontist with tools that were not available to the clinician before, and facilitated interactive image manipulation and enhancement to visualize the area of interest as a 3D volume. Lack of distortion, magnification, artifacts associated with conventional radiography, and the relative low radiation dose in comparison with medical-CT will result in more clinicians adopting such technology to enable accurate diagnoses and treatment planning, in addition to long-term follow-up and evaluation of healing.

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Periodontal flap procedures

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Abstract

The goal of a dental treatment is to achieve and maintain the optimal aesthetics function and heath of the dentition. This goal can be better achieved applying proper therapy when the etiology and pathogenesis of the disease are thoroughly understood. Each and every periodontal surgical procedure is having its own indications. When employed judiciously, in appropriate clinical situations, the clinician is able to draw predictable success even in complicated cases.

Introduction

Over the years, periodontal therapy has been influenced by trends of times and consequently treatment approaches have been modified accordingly. The goal of a dental treatment is to achieve and maintain the optimal aesthetics function and heath of the dentition. This goal can be better achieved applying proper therapy when the etiology and pathogenesis of the disease are thoroughly understood. Clinicians began to prove in 1980s, that pocket elimination was not essential for the success of periodontal therapy, that the control of subgingival infections was sufficient. This approach became to be known as Non Surgical Therapy.

Flap surgical procedures developed by Neuman, Widman and Ceiszensky were introduced in Europe and brought to America by Zentler. The early concept behind these procedures was to gain access to remove the alveolar crest that was necrosed by periodontal disease.[1] In 1935, Kronefeld showed in autopsy material that the bone was neither necrotic nor infected but destroyed by an inflammatory process housed within the soft tissues.[2] This osteitis could be reversed and bone formation stimulated if the inflammatory process in the gingiva was controlled. This change in concept gave rise to the popularity of Gingivectomy – as practiced by Orban, Glickman, Waerhaug and Ramfjord. Gottlieb in 1927 had already stated that "presence of pocket is a chief prerequisite for the existence of pyorrhea, with bacterial activity and inflammation as a secondary importance". The pocket was considered as a self perpetuating entity. Bunting et al in 1928 published his concept that the disease was preventable by a simple rational form of therapy. He appealed to "clean it up and keep it clean" with reference to the diseased tooth roots. But it was not until 1950s that the importance of tooth itself in the etiology of periodontal disease was stressed. Bacterial plaque and its products were considered as the etiologic agents for periodontitis. Studies of Waerhaug and coworkers opened the door towards the better understanding of the microbiology of periodontitis. Gradually interest and emphasis shifted over years from the bone to soft tissues and from soft tissues to the tooth surface.

Today the objectives of periodontal surgery include:

1. Access to roots and alveolar bone to enhance visibility, increase scaling and root planning effectiveness and to decrease tissue trauma
2. Modification of osseous defects to establish physiologic architecture of hard tissue through regeneration or resection augment alveolar ridge defects
3. Repair or regeneration of the periodontium
4. Pocket reduction to enhance maintenance by patient and therapist and improve long term stability
5. Provide acceptable soft tissue contour to enhance plaque control and maintenance and improve esthetics.

Classification for Periodontal surgery :

1. Pocket reduction surgery

a. Resective -

i. Gingivectomy

ii. Apically displaced flap

iii. Undisplaced flap with or without osseous resection

b. Regenerative

i. Flaps with graft

ii. Flaps with membrane

iii. Platelet concentrates etc

Indications and contraindications for periodontal surgery are outlined below:

Indications	*Contraindications*
• Access to root and osseous defects ·	• Uncontrolled medical conditions like – uncontrolled asthma, uncontrolled hypertension, uncontrolled diabetes
• Resective surgery ·	
• Regenerative surgery ·	• Poor plaque control
• Preprosthetic surgery	• High caries rate
♦ Crown lengthening	
♦ Gingival augmentation	
♦ Ridge augmentation	• Unrealistic patient expectations or desires
♦ Tori reduction	
♦ Tuberosity reduction	
♦ Vestibuloplasty	
• Periodontal plastic surgery	
♦ Esthetic anterior crown lengthening	
♦ Soft tissue grafting for root coverage or to obtain on physiologic gingival dimension	
♦ Papilla reconstruction	
• Gingival enlargement	
• Biopsy	
• Implant surgery	
• Treatment of periodontal abscess	
• Exploratory surgery	·

2. Correction of anatomic or morphologic defects

a. Plastic surgical techniques to widen attached gingival

i. Free gingival grafts
ii. Other techniques etc

b. Esthetic surgery

i. Root coverage
ii. Recreation of gingival papilla

c. Pre prosthetic techniques

i. Crown lengthening
ii. Ridge augmentation
iii. Vestibular deepening etc

d. Placement of dental implants

Periodontal pocket reduction surgery limited to the gingival tissue only and not involving the underlying osseous structures can be classified as gingival curettage and gingivectomy. The word "curettage" means scraping of the gingival wall of a periodontal pocket to separate diseased soft tissue. Gingival curettage offers the removal of inflamed soft tissue lateral to the pocket wall. Sub gingival curettage is performed apical to the epithelial attachment, severing the connective tissue attachment down to the osseous crest. Some degree of curettage is done unintentionally when scaling and root planning is performed and is called inadvertent curettage.

Curettage accomplishes the removal of the chronically inflamed granulation tissue that forms in the lateral wall of the periodontal pocket and the underlying junctional epithelium. This purpose of curettage is still valid particularly when an attempt is made at new attachment, as occurs in infrabony pockets.

The major drawbacks of gingival curettage are that healing after curettage results in formation of long junctional epithelium, which is the same as for scaling and root planning (SRP). Though a surgical procedure in nature, curettage is a "closed" procedure & doesn't offered improved visible access to root sun face as seen with flap surgeries to completely eliminate calculus biofilms from root surface. Short and long term clinical trials have informed that gingival curettage provides no additional benefit when compared to SRP alone in forms of probing pocket depth (PPD), attachment gain or inflammation reduction. After comparing SRP alone to

curettage plus SRP it was concluded that "Curettage did not serve any additional useful purpose. Following which 1989 Chicago world workshop in Clinical Periodontics concluded that "curettage had no justifiable application during active therapy for chronic adult periodontitis".[1]

Gingivectomy and undisplaced flaps are the two techniques that surgically remove the pocket wall. Gingivectomy means excision of the gingiva. By removing the pocket wall, gingivectomy provides visibility and accessibility for complete calculus removal and thorough smoothing of the roots, creating a favorable environment for gingival healing and restoration of a physiologic gingival contour. To perform this technique the clinician should determine that enough width of attached gingiva that will remain after removal of the pocket wall.

Gingivoplasty is similar to gingivectomy, but its purpose is different. Gingivectomy is performed to eliminate periodontal pockets and includes reshaping as part of the technique. Gingivoplasty is a reshaping of the gingiva to create physiologic gingival contours, with the sole purpose of recontouring the gingiva in the absence of pockets. Gingival and periodontal diseases often produce deformities in the gingiva that interfere with normal food excursion, collect plaque and food debris, and prolong and aggravate the disease process. Gingival clefts and craters, shelf like interdental papillae caused by acute necrotizing ulcerative gingivitis, and gingival enlargement are examples of such deformities that could be eliminated through gingivoplasty.

The decision concerning what type of periodontal surgery should be performed and how many sites should be included is usually made after the effect of initial cause-related measures have been evaluated. The time lapse between termination of initial cause related phase of therapy may vary from 2 weeks to 6 months. The consensus report from AAP world workshop agreed that a 4 to 6 week interval was usually adequate to assess the initial response to therapy.

In full thickness flaps, all the soft tissue, including the periosteum, is reflected to expose the underlying bone. This complete exposure of, and access to, the underlying bone is indicated when resective osseous surgery is contemplated, for pockets that extend beyond mucogingival junction, areas with minimal keratinized / attached gingiva, for regenerative and other restorative procedures, asymmetrical or unesthetic gingival topography etc. But in areas of esthetic zones, inadequate keratinized gingival and teeth with poor prognosis – like increased mobility, poor crown: root ratio or advanced CAL full thickness flaps are not advised.

Although full thickness flaps eliminates pockets, preserves the existing attached gingiva, heals by primary intention, helps in relocating frenum, for displacing flaps apically, coronally or unpositioned it still has disadvantages too which include:

1. Cannot be combined with other procedures to increase the zone of attached gingival with exposure of bone
2. Difficult procedure
3. Should not be used on presence of thin periodontium where dehiscence or fenestrations exist
4. Apically positioning of flap can cause root exposure, sensitivity, cosmetic and phonetic problem especially in anterior region

The partial thickness flap includes only the epithelium and a layer of the underlying connective tissue. The bone remains covered by a layer of connective tissue, including the periosteum. This type of flap is also called the split thickness flap. The partial thickness flap indicated when the flap is to be positioned apically or when the operator does not desire to expose the bone.

The technique for partial thickness flaps uses a sharp dissection parallel to the bone, leaving a periosteal covering in an attempt to protect the underlying bone, eliminate pockets, reduce postoperative pain and shorten healing time. There are conflicting data regarding the advisability of uncovering the bone when this is not actually needed. When bone is stripped of its periosteum, a loss of marginal bone occurs, and this loss is prevented when the periosteum is left on the bone. The differences, however, are usually not clinically significant, although sometimes they may be. The partial thickness flap may be necessary in cases in which the crestal bone margin is thin and is exposed when the flap is placed apically, or when dehiscences or fenestrations are present. The periosteum left on the bone may also be used for suturing the flap when it is displaced apically. A general rule of thumb to use in deciding whether a partial thickness flap should be used is as follows: If the root of the teeth can be palpated or visualized through the tissue, then a partial thickness flap should be used. This ability to palpate the roots through the tissue has been termed "washboard effect" and is generally representative of a thin periodontium with underlying dehiscences or fenestrations.

Flap designs can be conventional or papilla preservation flaps. In the conventional flap the interdental papilla is split beneath the contact point of the two approximating teeth to allow reflection of buccal and lingual flaps. The incision is usually scalloped to maintain gingival morphology with as much papilla as possible. When the interdental papilla is too narrow to permit the preservation of papilla or when the flap is to be a displaced then conventional flap are raised.

Conventional flaps include:

1. The modified Widman flap,
2. The undisplaced flap,

3. The apically displaced flap, and
4. The flap for regenerative procedures.

When the embrasures are wide enough to permit passage of the interproximal tissue the papilla preservation flap is used to incorporate the entire papilla in one of the flaps by means of crevicular interdental incisions to sever the connective tissue attachment and a horizontal incision at the base of the papilla, leaving it connected to one of the flaps. Though the papilla preservation flaps are technically difficult and time consuming, they offer the advantages of being esthetically pleasing, prevention of post operational tissue craters etc.

Mucoperiosteal (full thickness) or split-thickness flaps can also be used to reposition the gingiva apically to retain most, if not all, of the attached gingiva to eliminate pockets, laterally to position gingiva over areas of recession; or coronally to replace gingiva in broad areas of recession. The apically positioned flaps serves the objectives of surgically eliminating deep pockets, providing access for osseous surgery, helping the treatment of infrabony pockets and also for root planning.

The typical indications for apically displaced flaps include -moderate to deep pockets where the base is apical to/ beyond the muco gingival junction, for treating furcation involved teeth and also for crown lengthening. It is better to avoid apically displaced flaps in esthetic zones and in patients at risk for root caries, since excessive root surfaces are often exposed.

The surgical approach to the palatal area differs from that of other areas whereof the character of the palatal tissue and the anatomy of the area. The palatal tissue is all attached, keratinized tissue and has none of the elastic properties associated with other gingival tissues. Therefore, the palatal tissue cannot be apically, laterally or coronally displaced, and a partial thickness flap cannot be accomplished. There are 3 types of palatal flap design: full thickness flap, partial thickness flap, and modified partial thickness flap. The objective and result of all 3 are the same – a thin, even flowing gingival architecture that closely approximates the underlying bone.

The palatal approach procedure is contraindicated when a broad shallow palate do not permit a partial thickness flap to be raised with possibly damaging the palatal artery. The purpose of the palatal flap should be considered before the incision is made. If the intention is debridement, then, internal bevel incision is planned to place the final flap at the tooth-bone junction.

If osseous resection is necessary, then incision is planned to compensate for the lowered level of bone when the flap is closed. In areas that require osseous surgery, for pocket elimination, or for reduction of enlarged and bulbous tissue the palatal flaps can be advocated. Palatal flaps offer esthetics, easier access for osseous surgery since the palatal embrasure is wider than buccal embrasure and also palatal side being a natural cleansing area.

The retromolar area of the mandible and the tuberosity area of the maxilla offer unique problems to the clinician. They generally have enlarged tissue, unusual underlying osseous topography, and in case of retromolar area, a fatty, glandular, mucosal type tissue. Historically, while periodontal surgical techniques were being developed for all other areas, development in this one area remained stagnant, and gingivectomy was the treatment of choice.

The distal wedge operation is now the technique of choice in these regions as it overcomes the shortcomings of the gingivectomy procedure, which did not allow treatment of irregular osseous deformities or access to the maxillary distal furcation area. The retromolar area often has minimal keratinized tissue, and the tissue is often mucosal glandular tissue for which gingivectomy cannot be used. The wedge is the only possible way to thin and reduce the tissue in this procedure.

The distal wedge operation helps in maintenance of attached tissue, access for treatment of both the distal furcation and the underlying osseous irregularities, closure of a mature thin tissue, which is especially important in retromolar area, and provide greater opening and access when done in conjunction with other flap operations.

The basic 4 wedge designs are Triangular, Square, parallel or H design (linear), or pedicle (trap door), and the Modified pedicle. Although the triangular or linear distal wedge procedure, can be used in mandibular retromolar pad area, if adequate keratinized tissue is present, and the trap door technique may be better suited for this area when there is minimal keratinized tissue.

Triangular wedge incision are placed creating the apex of the triangle close to the hammular notch and the base of the triangle next to the distal surface of terminal tooth. The incisions are continuous with the buccal and the palatal inverse bevel incision used in the remainder of the surgical site. This type of wedge incision is preferred in cases where there is adequate zone of keratinized tissue, or in very short or small tuberosity. But, a small area adjacent to the tooth usually is not completely closed and heals by secondary intention.

The parallel type of wedge design incorporates 2 parallel incisions over the crest of the tuberosity that extend from the proximal surface of the terminal molar to the hammular notch area. The distance between the two linear incisions is determined by the thickness of the tissues, wider separation of incisions needed in thicker tissues. Vertical releasing incision (T) is placed perpendicular and at the ('H') posterior aspect of the linear wedge, to allow greater access to the underlying

bone. Thinning incisions and removal of the distal wedge are completed in a similar fashion as in triangular wedge. This type of incision is indicated when tuberosity is longer, and for greater access to distal furcation. The trap door procedure will preserve the existing keratinized tissue, but still allow internal thinning of tissues and apical positioning of flaps.

Criteria for Method Selection

Scientific criteria to establish the indications for each technique are difficult to determine. Longitudinal studies following a significant number of cases over a number of years, standardizing multiple factors and many variables, would be needed. Clinical experience, however, has suggested the criteria for selecting the method to be used to treat the pocket in individual cases. The selection of a technique for treatment of a particular periodontal lesion is based on a number of considerations:

1) Characteristics of the pocket: depth, relation to bone, and configuration.

2) Accessibility to instrumentation, including presence of furcation involvements.

3) Existence of mucogingival problems.

4) Response to Phase I therapy.

5) Patient cooperation, including ability to perform effective oral hygiene and, for smokers, willingness to stop their habit at least temporarily (i.e., a few weeks).

6) Age and general health of the patient.

7) Overall diagnosis of the case: various types of gingival enlargement and types of periodontitis (chronic marginal periodontitis, localized aggressive periodontitis, generalized aggressive periodontitis, and so forth).

8) Esthetic considerations.

9) Previous periodontal treatments.

10) Type of surgical procedure

11) Surgical site

12) Nature or consistency of the pocket wall

Each of these variables is analyzed in relation to the pocket therapy techniques available, and a specific technique is selected. Of the many techniques, the one that would most successfully solve the problems with the fewest undesirable effects should be chosen. Clinicians who adhere to one technique to solve all problems do not use to the advantage of the patient the wide repertoire of techniques at their disposal.

Conclusions

Over the years the science of periodontology has witnessed evolution of an array of surgical techniques with varying range of predictability. As mentioned in the text each and every such procedure is having its own indications. When employed judiciously, in appropriate clinical situations, the clinician is able to draw predictable success even in complicated cases. For this it is our therapeutic responsibility to keep in pace with the newer techniques emerging in the field to deliver the best possible periodontal care for the patient.

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Case report

Unusual foreign object in root canal

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Abstract

Foreign objects in the root canal are rarely found during root canal treatment and if a foreign object is accidentally deposited in the root canal by the patients themselves, it is reported as unusual finding in the literature. Various objects such as a pin, sewing needle,3 U.M. Nadkarni, A. Munshi, S.G. Damle and R.R. Kalaskar, Retrieveal of a foreign object from the palatal root canal of a permanent maxillary first molar: a case report, *Quintessence Int* 33 (2002), pp. 609–612.staple, piece of glass bead, wooden toothpick, plastic objects, toothbrush bristles, and crayons have been reported. Removal of these objects, though often very difficult, is essential for proper endodontic treatment and its successful outcome.

A case is presented in which an unusual object- a 'U' shaped piece of copper wire was retrieved under operating microscope using both K and H files.

Introduction

Foreign objects in the root canal can be a source of recurrent infection. Furthermore it hinders with the proper instrumentation of the canal and thus compromises the outcome of endodontic treatment. The patient may be symptomatic or asymptomatic. Routine radiographs may accidently reveal these objects if they are radio opaque. Their removal is essential for better prognosis of the tooth. Removal of foreign body is often very difficult, depending on its shape, size, position, and number. Various techniques have been suggested in the literature, though no standardized technique is universally followed. However, a detailed patient's history, together with clinical and radio graphical examination (preferably at different horizontal angulations), is helpful in the evaluation when a foreign object is suspected.

Case report

An 18 year old male patient reported to the Department of Conservative Dentistry and Endodontics, Government Dental College, Trivandrum complaining of discoloration of upper front teeth (fig 1). He reported a history of fall from bicycle at the age of 12 years, leading to fracture of the front teeth. He also reported frequent episodes of 'itching' sensation associated with the teeth, which was relieved by inserting tooth pick, metal wires etc… in to the teeth. Clinical examination revealed Ellis class III fracture of both maxillary central incisors. There was no pain or mobility associated with the teeth. Radiographic examination revealed a 'U' shaped radio opaque mass at the junction of middle and cervical thirds of root canal of upper left central incisor (fig 2).

It was decided to remove the foreign body, followed by root canal treatment of both teeth. Tooth was isolated and access cavity was prepared. Cavity was modified until foreign body could be clearly seen under operating microscope. No instrument was inserted until clear vision was achieved, as blind instrumentation could push the body further apically and make the removal more difficult or impossible.

A No. 10 k-file was introduced, sliding along the walls of the canal, in an attempt to bypass the foreign body. 17% EDTA gel (Glyde, Dentsply) was used liberally to aid this. Circumferential attempts were made around the body, until it bypassed at a point. Maintaining the instrument in position, an IOPA radiograph was taken to confirm the same. Patency of the bypass was established by movement of the file. This was followed by instrumentation using No. 15 and 20 K files. Care was taken not to lose the sight of the body. Then a No. 20 H file was introduced in an attempt to engage the body. After several attempts, the body was mobile. Continued attempts moved the body coronally. It was then gripped with a small artery forceps and pulled (fig 3,4)

Then the canal was irrigated with normal saline. Working length was determined for both the teeth (fig 5). Cleaning and shaping of root canal was done using step back technique. Apices of both teeth enlarged up to No. 80 size K file. Calcium hydroxide was given as intracanal medicament mixed with chlorhexidine gel and closed dressing given. In the next appointment obturation of both teeth done using lateral condensation technique (fig 6). Since the coronal structure of upper left central incisor was less, post and core restoration was planned for the tooth. Since the canal wall has less

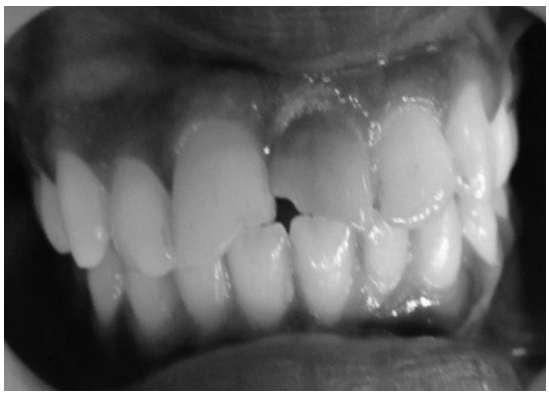

Fig 1. pre-operative photograph

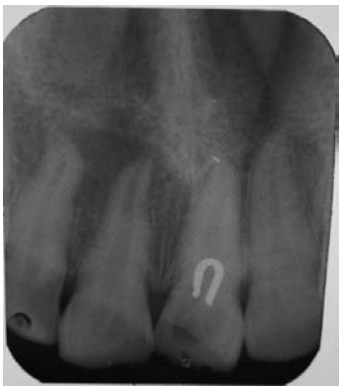

Fig 2. pre-operative radiograph

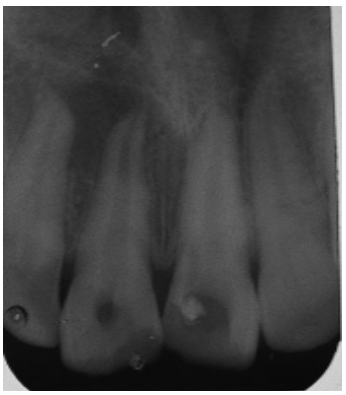

Fig 3. post-operative radiograph

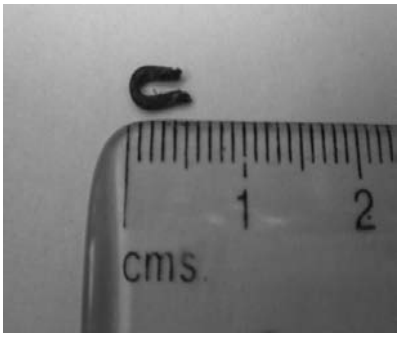

Fig 4. foreign body removed

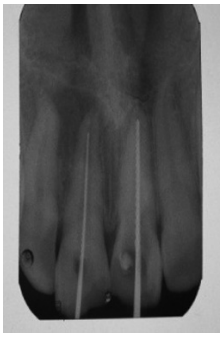

Fig 5. working length radiograph

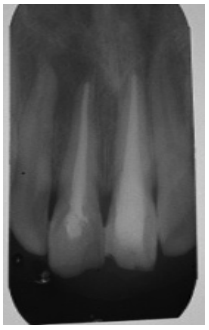

Fig 6. post obturation radiograph

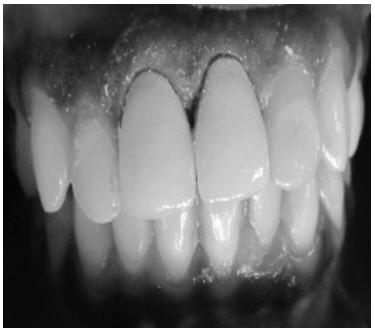

Fig 7. post-operative photograph

thickness, composite resin was used to reinforce the canal followed by insertion of fiber post. Core build up was done with composite resin; tooth preparation was done and restored with porcelain fused to metal crown (fig 7)

Discussion

Various techniques to remove foreign objects from the root canal have been explained in the dental literature which includes

- Use of K files and H files
- Use of Stieglitz pliers to remove the silver points[1]
- Grossman has suggested chloroform or xylene can be used to soften gutta percha which is then easily removed with a file or a barbed broach[2]
- A simple device consisting of a disposable 25-gauge dental needle, a segment of thin steel wire and a small mosquito hemostat to remove silver cones from the root canals as described by Riog –Greene[3]
- Fors & Berg described a technique that required removal of internal root structure before the foreign object is removed.[4]
- The Masserann technique, described by Williams and Bjorndal to remove the fractured post.[5]
- Ultra sonic scaler to remove solid objects form the root canal.[6]
- Meidinger and Kahes successfully used the Cavi-Endo ultrasonic instruments to remove a broken bur tip and amalgam particles from intra canal spaces.[7]
- Taintor et al described various methods for removal of silver cones[8]
- Micro tube removal systems like Lasso & anchor, Tube & glue, Tap & thread, Endo extractor instrument removal system.

In the presented case, it was planned initially to attempt using K file and H file, without further removal of canal dentin, as the walls were already thin. Continuous vision under operating microscope ensured that the body was not pushed apically. Also vigorous instrumentation and twisting of files were avoided to prevent fracture of files in the canal.

Some endodontic treatments cannot be achieved the way in which they were previously planned since the patient is not able to continue the treatment. If the period

between preparation and root canal filling is extended, some unexpected complications may appear. If the root canal is open, the patient may try to clean the obstructed food substances in the canal with various objects, which may break and get lodged in the pulp space. Although the literature suggests the successful removal of foreign objects, patient compliance during treatment may be a problem. When the prognosis is good and the tooth is valuable, a more radical treatment with combination of orthograde and retrograde intervention may be needed for patients in order to save the tooth.

Conclusion

No standardized procedure for successful removal of unusual foreign objects even in difficult cases exists, but a number of different techniques are recommended. Specialized radiographic techniques such as radiovisiography and 3D CAT (computerized axial tomography) scans can play a pivotal role in the localization of the exact position of these foreign objects inside the root canal. However this kind of procedure depends on the operator experience and also, what and where the foreign objects are found. Microscopy and ultrasonic tips are used as auxiliary tools, increasing the chance of removal and ensuring the integrity of the tooth structure. Patience, care and appropriate techniques may be helpful in retrieving foreign bodies and avoiding periapical surgery. Complicated crown fractures should be managed properly, and prolonged open drainage should be avoided in children to minimize the risk of foreign body impaction.

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Mandibular first molar–its morpho-anatomic variations

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Abstract

Mandibular molars are known to have complex anatomy and can be deceptively difficult to treat. They can have additional roots and root canals. With increasing reports of aberrant canal morphology, the clinician needs to be aware of these varied anatomy. This article attempts to review the multiple anatomic variations associated with the mandibular first molar.

Introduction

In terms of success of endodontic treatment, knowledge of pulp anatomy cannot be overstated. A statistically significant percentage of failures are related to missed root canal system.[1] Missed canal systems potentially hold tissues, bacteria and related irritants that inevitably contribute to clinical symptoms and lesions of endodontic origin.

Mandibular molars are known to have complex anatomy and can be deceptively difficult to treat. The majority of mandibular first molar are two rooted with two mesial canals and one distal canal.[2] An additional third root located distolingually on mandibular molars, called the Radix Entomolaris, was first mentioned in literature by Carabelli.[3] An additional root at the mesiobuccal side is called the Radix Paramolaris.[4] Like the number of roots, the number of root canals also may vary. In approximately 30% of mandibular first molars there is a second distal canal system.[5] Though rare a third middle distal canal has also been reported.[6] A less well known, but nonetheless important canal, the middle mesial canal system may also be present.[7, 8] Another rarity that may be encountered is the C shaped canal.[9]

Radix Entomolaris (RE) and Radix Paramolaris (RP)

Morphology

RE is located distolingually in mandibular molars, mainly first molar. The identification and external morphology of these root complexes has been described by Carlsen and Alexandersen.[10] In general RE is smaller than the distobuccal and mesial roots and can be separate or partially fused with the other roots.

Carlsen & Alexandersen has described four different types of RE based on their location of cervical part as types A, B, C, AC.[8] This classification allows for identification of separate & non separate RE.(Fig 1)

Types A & B - refers to RE having distally located cervical part with two normal and one normal distal root component respectively.

Type C – refers to a mesially located cervical part.

Type AC – this RE has a cervical part located centrally between distal & mesial root components.

Based on the external root morphology & scouting of root canals of the RE, de Moore et al has proposed a classification: [11]

Type 1 – straight root canal

Type 2 -- initially curved entrance & continues as a straight root/ root canal

Type 3- initially curved in the coronal one third of root canal & a second buccally oriented curve starting from middle to apical 1/3.

The RP on the other hand is located mesiobuccally. Its size may vary from that of a mature root with a root canal to that of a short conical extension.

Carlsen and Alexandersen describe two different types.[4]

Type A – cervical part is located on the mesial root complex.

Type B – cervical part is located cervically between the mesial and distal root complex.

Though an additional root canal need not always be associated with an extra root, additional roots are nearly always associated with an increase in number of cusps and either an increase in number of root canals.

Prevalence

From the many studies reporting the incidence of occurrence of RE in ethnic population a conclusion can be drawn that RE occurs in higher frequency in certain

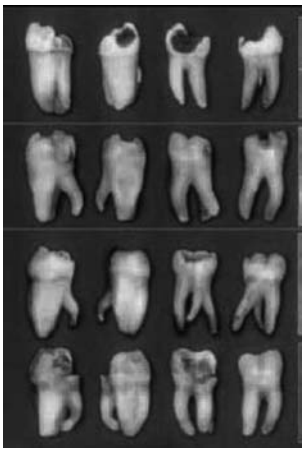

Fig 1. The different views of the three types of RE.

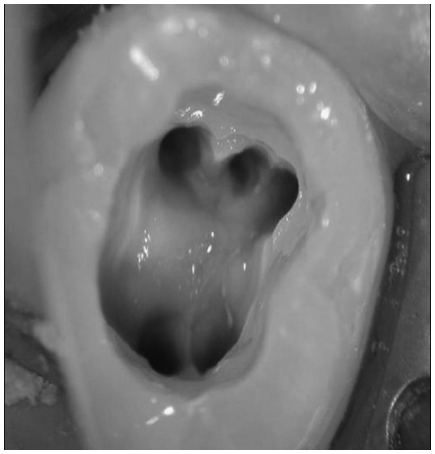

Fig 2. The middle mesial canal following access preparation.

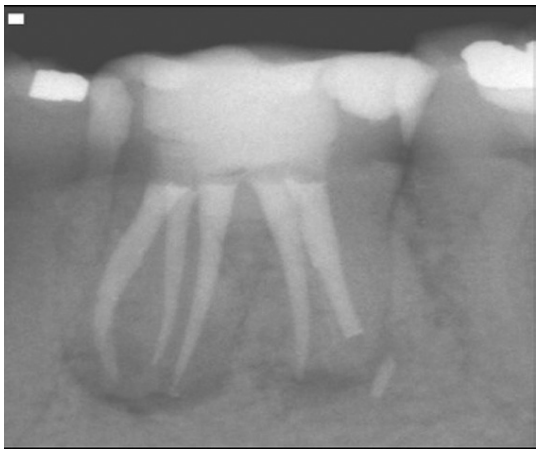

Fig 3. An independent middle mesial canl following obturation.

ethnic groups. Sperber etal reported a maximum frequency of 3% in African population.[12] A literature review shows Eurasian and Indian population to have a frequency of 5%, 5-30% for Mongloid population and 3.4 – 4.2% in the Caucasians.[13] Studies report a bilateral occurrence from 50- 67%. RE can be found on mandibular first, second and third molar, occurring least frequently on second molar.[14] RP occurs much less frequently than RE. Studies have reported RP in mandibular first, second and third molar, occurring more frequently in the third molar.[4]

Etiology

The etiology behind the formation of RE is still unclear. It has been suggested that this third root may develop during tooth bud morphodifferentiation as a result of developmental aberration of both ectoderm & mesoderm, its severity depending on the formation stage of the involved teeth. It has also been suggested that while racial factors play a predominant role in the formation of eumorphic roots, i.e where it is a normal morphological variant, external factors during odontogenesis are responsible for the dysmorphic or the unusual root morphology.[15]

Clinical technique

The presence of RE or an RP has clinical implication in endodontic treatment. An early identification of this root helps in modifying the traditional triangular access opening. Two preoperative radiographs with one taken at 20-30 degree horizontal angulation to the other, usually provides an accurate diagnosis of the presence of extra roots. An extra cusp (tuberculum paramolare) or more prominent distolingual lobe, in combination with a cervical prominence can indicate the presence of an additional root. A trapezoidal access preparation with shorter side to the distal & the longer side to the mesial helps in locating the DL canal orifice. The orifice of RE is located distolingually to mesiolingually from the main canal in the distal root. An initial relocation of the orifice to the lingual is indicated for the straight line access followed by the use of flexible Nickel –Titanium files with restricted enlargement of the coronal third.[15]

Extra canals

Middle Mesial Canal

This canal may be located anywhere between mesiobuccal and mesiolingual orifice. The canal itself may be independent or may join apically with mesio buccal or mesiolingual canals. In 1974 Vertucci and William as well as Barker etal described the presence of an independent middle mesial canal.[16,17] Fabra Campos (1989) in his study on 760 mandibular first molar found that the middle mesial canal was present in 2.6% of the cases examined.[18] Pomeraz etal from his study classified the middle mesial canal into three morphological categories as fin, confluent and independent.[19] (Table 1)

Clinical Technique

Though preoperative radiographic analysis is critical for endodontics, multiple angled radiographs themselves may be of little value in the identification of middle mesial canal. Illumination and magnification plays a significant role in identifying this anatomic feature. The mesial extension of the access cavity should extend to almost incorporate the mesiobuccal, mesiolingual cusp tip and run parallel to mesial marginal ridge. The middle mesial canal may be found anywhere in the pulp chamber wall or floor fold between the mesiobuccal and mesiolingual canal orifice (Fig 2 and 3). Ultrasonic tips will be very useful in searching for these elusive canals. Their tip size being nearly 10 times smaller than the smallest round bur a conservative dentin removal can be done without obstructing vision. The canal system

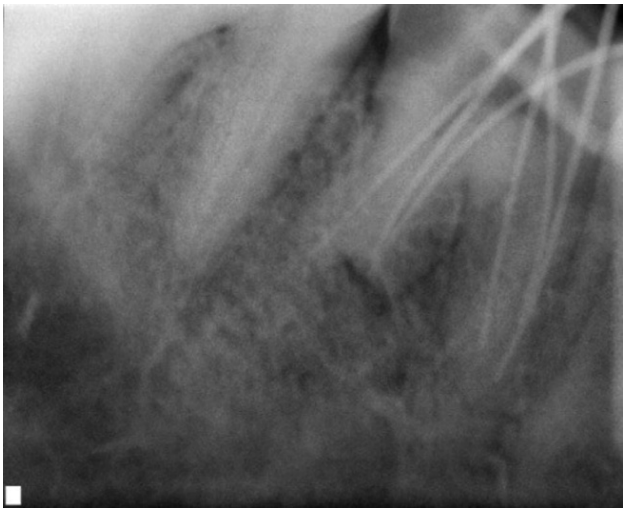

Fig 4. A mandibular first molar with RE, middle mesial canal and extra distal canals.

TABLE 1. Mandibular first molar comprehensive studies

Investigator	Year	Teeth	Method	Roots	Three Canals
Skidmore and Bjorndol	1971	45	Vitro	Mesial	—
				Distal	—
Pineda and Kuttler	1972	300	Vitro	Mesial	—
				Distal	—
Vertucci	1984	100	Vitro	Mesial	1.0%
				Distal	—
Pomeranz et al.	1981	100	Vivo	Mesial	12%
				Distal	—
Martinez-Berna and Badanelli	1983	1418	Vivo	Mesial	1.5%
				Distal	—
Fabra-Campos	1985	145	Vivo	Mesial	2.1%
				Distal	0.6%
Fabra-Campos	1989	760	Vivo	Mesial	2.6%
				Distal	—
Goel et al.	1991	60	Vivo	Mesial	15.0%
				Distal	—

Table 2 *Incidence of two canals in distal root of mandibular first molar*

Author/ Year	Incidence (%)	Population group
Skidmore and Bjorndal (1971)	28.9	Caucasians
Vertucci and Williams(1974)	30	Caucasians
Yew and Chan (1993)	31.5	Chinese
Zaatar et al (1997)	29.9	Middle East
Gulabivala et al (2001)	20	Burmese
Gulabivala et al (2002)	33.4	Thai
Sen et al (2004)	46	Turkish

should be prepared cautiously and conservatively. An increased use of rotary Ni-Ti files leads to a better centered preparation. However since the anatomy of the mesial root is 'hour glass' shaped this kind of centered preparation automatically bring it close to the 'danger zone' thereby leading to a possibility of strip perforation.[8]

Extra Distal Canals

In the distal root there is usually one canal. However many researchers have studied the presence of two canals in the distal root of mandibular molars.[20] (Table 2). The results vary from 43.3% to 11.2% in Skidmore and Bjorndal's study.[5] Though very rare, a third distal canal called the middle distal canal can also occur.[6] (Fig 4). A more buccal or lingual location of the located distal canal should always be followed by searching for a second canal towards the opposite side. A trapezoidal access preparation greatly helps in locating the second canal. Tracing the dentinal map connecting distobuccal and the distlingual canal helps in identifying a middle distal canal, if present.

The C shaped canal

An anatomical variation that may be seen in a mandibular molar, though rare in a first molar is the C shaped canal.[9] This was first described by Cooke and Cox in 1979.[21] This is a ribbon shaped canal that includes the mesiobuccal and distal canal and sometimes the mesiolingual canal. Sometimes instead of having several discrete orifices, the pulpchamber of C shaped canal is a single ribbon shaped orifice with a 180 arc, which starts at the mesiolingual line angle and sweeps around the buccal to the end at the distal aspect of the chamber.

Etiology

A failure of Hertwig's epithelial root sheath to fuse results in a C shaped root, which always contain a C shaped canal.[22]

Melton has classified these canals based on their cross sectional shape into

Category 1 – continuous C shaped canal running from pulp chamber to apex without any separation.

Category 2 – the semicolon(;) shaped orifice, where

dentine separates the main C shaped canal from one mesial distinct canal.

Category 3 – refers to those with two or more discrete and separate canals.

Clinical technique

Preoperative radiographs are usual of not much help. The C shaped canal must be suspecte when the roots are fused or close to each other. The canal system can be identified following routine access preparation. Fiber optic trans illumination is an useful adjunct in identifying the canal. Care should be taken while instrumenting the isthmus portion of the C shaped canal. Overzealous enlarging can lead to strip perforation. Through use of the smaller sized file along with sodium hypochlorite as the irrigant helps in maximum debridement. A thermoplastisized obturation technique is a more appropriate method of obturation.[22]

Conclusion

It is imperative that aberrant anatomy is identified prior to and during root canal treatment of teeth. The presence of extra root and the relatively high incidence of canal isthmus in mesial root of mandibular molar, indicates the necessity to carefully explore the root canal anatomy. While searching for every additional way through this intricate system and its possible portal of exit, microscopes are valuable adjuncts, more so in such complex cases. The morphological variation in mandibular first molar in terms of extra roots and multiple root canals demand a careful and adapted clinical approach to avoid or overcome procedural errors during endodontic therapy.

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Re-attachment of anterior teeth fragments

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Abstract

Trauma to the anterior teeth is relatively common among children and teenagers. Re-attachment of a fractured fragment to the remaining tooth can provide better and long lasting esthetics, improved function, a positive psychological response and is a faster and less complicated procedure. This article presents a comprehensive literature review on various techniques used to restore the dental trauma.

Introduction

Fracture of anterior teeth by trauma is a common problem in children and young adults. Such injuries because of their frequency, functional and aesthetic disturbances that accompany these should be treated without delay.[10]

Future vitality of the teeth, absence or presence of complications later, all depends on the accuracy and judgement used for the management of the case. Many studies have reported reviews that one out of every four persons under the age group of 18 had sustained traumatic dental injury in the form of an anterior crown fracture.

The etiology for dental injuries may be falls in infancy, child physical abuse, falls and collision, bicycle injuries, sports related injuries, horse back riding, automobile injuries, assaults, torture, mental retardation, epilepsy and seizures, drug related injuries etc…[4]

Different classification systems of traumatic tooth fractures appear in the literature:

(Table 1, 2, 3,& 4)

Inspite of differences in the classification systems, a majority of the studies agree in several aspects.

1. The most common injuries are uncomplicated crown fractures (Ellis Class I & II, Andreasen Class I, II & III.
2. Children & teenagers are most affected with boys being the highest risk group.
3. Upper central incisors are most affected.

Re-attachment of tooth fragments should be the first choice & is a viable alternative to conventional with minimal or without violation of biologic width, because of simplicity, natural esthetics, conservation of tooth structure.

Background

- Chosack & Elldeman published the first case report on re-attachment of a fractured incisor fragment in 1964.
- In 1977 Spasser performed the endodontic treatment and the tooth fragment was retained with three dentin pins.
- In late 1970's, Tennery (1978), Starkey (1978) and Simonsen (1979) reported cases of fragment reattachment using enamel etching and resin composites

Literature discussion

There are several re-attachment techniques adapted to strengthen the tooth structure. They are

1) Enamel bevelling
2) V shaped internal enamel groove
3) Internal dentin groove
4) External chamfer
5) Overcontour
6) Simple re-attachment

I. Enamel bevelling

Several case reports advocate enamel bevelling of the fragment and the remaining crown.[7,16,20,25] In some case reports; this technique is performed only on the lingual surface[21] instead of the whole fractured area (circumferential bevel). This technique has claimed to improve fragment retention since enamel bevelling alters the enamel prisms orientation, allowing for achievement of a more effective acid etching pattern.[20] This technique also improves short term esthetics.

II. V - shaped internal enamel groove

Another technique commonly reported in the literature is placement of a V shaped internal groove[9,13,21]

Table 1 : *Andreasen & Andreasen's Classification (1993)*

Class I	Enamel infraction (crack)
Class II	Enamel fracture (crown fracture, not complicated)
Class III	Enamel-dentin fracture (crown fracture, not complicated)
Class IV	Complicated crown fracture
Class V	Crown-root fracture, not complicated
Class VI	Complicated crown-root fracture
Class VII	Root fracture

Table 2 : *Ellis & Davey's Classification (1970)*

Class I	Simple crown fracture with enamel involvement
Class II	Extended crown fracture with dentinal involvement, without pulp exposition
Class III	Extended crown fracture with dentinal involvement, with pulp exposition
Class IV	Non vital teeth, with or without loss of crown tissues
Class V	Traumatically avulsed teeth
Class VI	Crown fracture, with or without loss of crown tissues
Class VII	Tooth luxation without crown or root fracture
Class VIII	Cervical crown fracture
Class IX	Traumatic injuries on primary dentition

Table 3 : *Spinas & Altana's Classification (2002)*

A Class	Simple enamel lesions involving 1 proximal angle or only incisal edge
B Class	Enamel-dentin lesions involving 1 proximal angle or only incisal edge
C Class	Enamel-dentin lesions involving the incisal edge
D Class	Enamel-dentin lesions involving mesial or distal angle & the incisal or palatal surface & root involvement

Table 4 : *Baratieri, Monteiro & Andrada's Classification (1998)*

A Class	Enamel fracture
	B 1 - without pulpal & biologic width involvement
	B 2 _ without pulpal involvement but biologic width violation
	B 3 _ with pulpal involvement & no biologic width violation
	B 4 _ with pulpal involvement & biologic width violation
B Class	Enamel-dentin fracture

which is then restored with resin composites. Clinically, this technique is difficult to perform due to the limited enamel thickness of anterior teeth.

However instead of placing a bevel in enamel, this technique can be performed in dentin. Placing an internal groove in dentin from the fragment & remaining tooth has been done in order to create space for a pulp capping agent[5,21] or for adhesive cement like glass ionomers.[7]

III. Internal dentin groove

The space provided by the internal dentin groove has been utilised as re-attachment reinforcement with resin composites.[17] Similarly this kind of reinforcement has already been performed in pulpless teeth, where part of the pulp chamber was filled with resin composite.[1,9] Some authors claim that this technique compromises esthetics, as the internal resin composite can modify the shade of teeth.[6,11]

IV. External chamfer

Reattachment of the fragment prior to placing an external chamfer in the fracture line by means of a diamond round bur especially when the region corresponding to the fracture line is still evident.[12,15] Chamfer placement has been performed on either the buccal[17] or lingual surface.[19] Some authors prefer a circumferential chamfer around the whole extension of the fracture line.[2]

V. Overcontour

Clinicians use the overcontour technique extensively.[17] After bonding the fragment, a superficial preparation (about 0.3mm deep) is placed on the buccal surface using a cylindrical diamond finishing bur extending about 2.5mm coronally and apically from the fracture line. This is then treated with a thin composite layer. This technique is useful when the fracture line is still evident after reattachment.

Exposure of the resin composite to the oral environment using the chamfer and overcontour technique may diminish the long term esthetics due to the process of abrasion and discoloration that occurs over time with composites.[3] Placing a lingual chamfer minimises the drawback.[11]

VI. Simple reattachment

Here no additional preparation made; only simple reattachment is done. Simple reattachment recovered only 37.1% of intact tooth fracture resistance, while buccal chamfer recovered 60.6% and the overcontour recovered 97.2% and internal groove technique reached intact tooth fracture strength with 90.5%.[11,17]

Conclusion

Reattaching fractured tooth fragments offer several advantages,

- the treatment is rapid, conservative and relatively atraumatic
- the restoration of original tooth contours and color is excellent
- incisal edge wear proceeds at the same rate as adjacent teeth, where as a composite restoration is likely to wear more rapidly
- esthetic appearance is excellent

Several aspects govern the choice of a technique for fragment reattachment. It is advised to perform the reattachment of fractured teeth with additional preparations. Clinicians should attempt to choose any one of the reinforcement techniques related in this review in order to improve the fracture strength of the reattachment technique.

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Case report

Anterior middle superior alveolar injection technique for maxillary periodontal surgery

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Abstract

Maxillary periodontal surgery traditionally needs multiple injections for achieving adequate local anaesthesia. Numbness of side of nose, lips, cheek are unnecessary sequelae which adds to the patients discomfort. This article highlights the single injection anterior middle superior alveolar (AMSA) block, the technique, its advantages, disadvantages and 2 periodontal surgical case reports.

Introduction

Until recently, providing adequate local anaesthesia of the maxillary arch for scaling/root planing, or periodontal surgery required 4 – 5 separate block or infiltration injections. It included the anterior superior alveolar, middle superior alveolar and posterior superior alveolar infiltration injections for buccal anaesthesia and nasopalatine blocks for palatal anaesthesia.[1]

In 1997 Friedman and Hochman introduced a novel single injection technique – anterior middle superior alveolar block (AMSA)[2]. This new field block produces anaesthesia to multiple maxillary teeth (central and lateral incisors, canines, premolars and the mesio buccal roots of the first molar), as well as well as their periodontal tissues on the buccal and palatal aspect including their pulp tissue. The uniqueness of this technique is that it involves a single needle prick.

Anatomy

Just before the exit of the maxillary nerve from the infra orbital foramen and while still in the infra orbital canal it gives off the anterior superior alveolar nerve, which runs in a canal in the anterior wall of the maxillary sinus to form the superior dental plexus. It supplies the pulp, investing structures and labial mucoperiosteum of anterior teeth, the maxillary centrals, laterals and the canines.

Approximately in the middle of the infra orbital canal it gives off the middle superior alveolar nerve. It runs downward and forwards in a canal in the lateral wall of the maxillary sinus to form part of superior dental plexus. It supplies the pulp, investing structures and buccal mucoperiosteum of premolars and mesio-buccal roots of the first molar.

Technique

0.6—1.4ml of local anaesthetic solution (2% lignocaine 1:100 000) was withdrawn into a 2ml syringe. Needle used was 27G 1".[3] Ideally the patient should be informed that the procedure will take approximately 5mins. The patient was placed in a supine position. The penetration site was determined, ie a point midway between the gingival crest bisecting the premolars and the median palatine raphe. It was also made sure that the penetration site can easily accommodate solution volumes. It was observed spongier sites worked better. A cotton swab was used to locate the site.

A topical anaesthetic gel was applied at the injection site for 1minute with a cotton swab. The needle was placed at the injection site with the bevel facing the palate. Slowly the needle was penetrated into the tissue until bone was felt. The needle was withdrawn 1mm and aspirated for blood. The anaesthetic solution was slowly deposited at the rate of 4mins for 1ml. If any excess blanching or ballooning of tissues occurs, it indicates deposition rates need to be reduced further.

Mode of action

The AMSA block was administered in the mid portion of the anterior palate through the fibrous palatal tissue. The anaesthetic was deposited in close proximity to the palatal bone, which was porous enough to permit the anaesthetic solution to diffuse through the tissues and anaesthetize both the anterior and middle branches of superior alveolar nerve. The AMSA block successfully anaesthetized the teeth extending from the mesio buccal root of first molar to the ipsilateral central incisor, the investing structures and the facial/palatal tissues.

Advantages

1. Provides widespread periodontal and pulpal anaesthesia with fewer injections.
2. AMSA block does not anaesthetize labial or buccal tissues. Therefore pre/post operative assessment of smile or lip line not affected during periodontal plastic surgery. Also less post operative discomfort to the patient.[4]

3. Decreased volume of local anaesthetic and vasoconstrictor drugs and therefore a better option for the cardiovascular compromised patient than the conventional local anaesthesia.
4. Better patient acceptance due to the single injection site.[5]
5. No vasoconstrictor affecting the buccal gingiva, therefore a better choice for soft tissue grafting.

Disadvantages

1. Slower onset of anaesthesia compared to conventional techniques. This may be due to the time it takes for the anaesthetic solution to pass through the palatine process.[6]
2. AMSA block is almost painless when the computer controlled local anaesthetic device (CCLAD) or Wand plus® was used compared to the conventional syringe and needle. CCLAD/Wand plus® is expensive.[7]
3. AMSA block can be performed successfully only if the recipient has a thick fibrous palatal vault for the anaesthetic solution.
4. Some patients may feel uncomfortable to have an injection that lasts for about 4mins. Attempts to speed up the procedure may lead to tissue trauma and pain.
5. Since less number of injection, less amounts of vasoconstrictor and therefore poor hemostasis.
6. Short lived anaesthesia of maxillary central incisors

Case-1

A 36 yr old female patient was referred to the Dept: of Periodontics, Sri Sankara Dental college, for the management of localized periodontitis between 23 and 24. After topical anaesthesia, a conventional 2ml syringe with a 27G 1" needle was loaded with 1ml of 2% lignocaine 1: 100 000. It was injected to the left palate between 24 & 25 at the midpoint of the line joining the gingival margin and mid palatine raphe. The anaesthetic solution was slowly injected in 4mins. The patient did not report any discomfort or severe pain. After 5mins the profoundness of the anaesthesia tested by probing. A mocoperiosteal flap was raised from 21 to 25. The area cleaned, debrided and root planning done before suturing. The patient did not report any numbness of lip or cheek. The surgery was uneventful. However it was observed that the hemostasis on the buccal flap was poor, hampering visibility. Effective suctioning is absolutely essential to overcome this.

Case-2

A 50yr old female patient with chronic generalized periodontitis was referred to the Dept: of Periodontics for salvaging the upper anterior teeth (14-25) for the purpose of prosthodontic rehabilitation. A bilateral AMSA block was performed similar to that in case-1. The patient did not report any discomfort throughout the surgical procedure, which took nearly 80 mins. The more than usual bleeding from the site required additional suctioning efforts and pressure packs to maintain visibility.

Discussion

As far as a patients psychology is concerned a needle prick is always a scary affair. If multiple needle pricks are needed as in periodontal flap surgery it produces a cumulative effect on stress for the recipient.[8] It is the Periodontists duty to provide a painless anaesthesia to the patient undergoing periodontal treatment thereby increasing the patients acceptance of the of the treatment procedures and thereby increased compliance of recall visits. There are many methods of local anaesthetic administration. The technique often selected depends on the area to be anaesthetized and the treatment procedure. AMSA has the ability to cover large maxillary fields with a single injection making it an excellent choice, though it has its own disadvantages.[9]

Conclusion

Though AMSA block has its own advantages and disadvantages it is just an alternative technique to achieve maxillary anaesthesia. It can in no way replace the traditional local anaesthetic techniques even with the usage of Computer controlled local anaesthetic device. AMSA may be useful in certain conditions and adds to the clinicians repertoire of anaesthetic techniques.

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Photodynamic therapy and its application in periodontics

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Abstract

Photodynamic killing of periodontopathogenic bacteria may be an alternative to the systemic application of antibacterial drugs used in the treatment of periodontal diseases. Even though the method is still in the experimental stage, increasing bacterial resistance problems may promote the introduction of photodynamic therapy into periodontal practice. Photodynamic therapy is significantly less invasive than other treatment for periodontal diseases. It can provide improved dentin hypersensitivity, reduced inflammation of tissue surrounding the teeth, and allows tissues to repair faster. Photodynamic therapy can be used as an alternative to antibiotic treatment.

Introduction

Periodontal therapy mainly aims at eliminating the deposits of bacteria by removing supragingival and subgingival biofilm. However, conventional mechanical therapy cannot completely remove all periodontal pathogens due to complex root anatomy. Hence adjunctive antimicrobial therapy was added. However, antimicrobial agents suffered two major drawbacks: first is the difficulty in maintaining stable therapeutic concentration in the periodontal pocket for sufficient length of time and second is the strong possibility of the development of resistance to antibiotics by the target organisms. Thus developed the concept of phototherapy. Dental lasers have been used as an effective means of treatment of periodontal pockets over a period of 20 years. However, the use of high level lasers resulted in irreversible thermal damage to surrounding periodontal tissues. Recently, a new type of non-invasive phototherapy called photodynamic therapy (PDT) has been introduced which uses a low level laser light.

Photodynamic therapy (PDT)

PDT also called photoradiation therapy, phototherapy or photochemotherapy was introduced in medical field in 1904 for the light induced inactivation of cells, micro-organisms or molecules. PDT basically involves three non-toxic ingredients: visible harmless light, a non-toxic photosensitizer and oxygen. It is based on the principle that a photosensitizor binds to the target cells and can be activated by light of a suitable wavelength. Each component is harmless by itself, but when combined they can produce lethal cytotoxic agents that can selectively destroy cells.

Mechanisms involved in antimicrobial PDT (aPDT)

The mechanism of action of aPDT is briefly described as:

- After irradiation with light of a specific wavelength, the photosensitizer at ground state is activated to a highly energized triplet state.
- The longer life time of the triplet state enables the interaction of the excited photosensitizer with the surrounding molecules.
- The triplet state photosensitizer follows two different pathways to react with biomolecules.

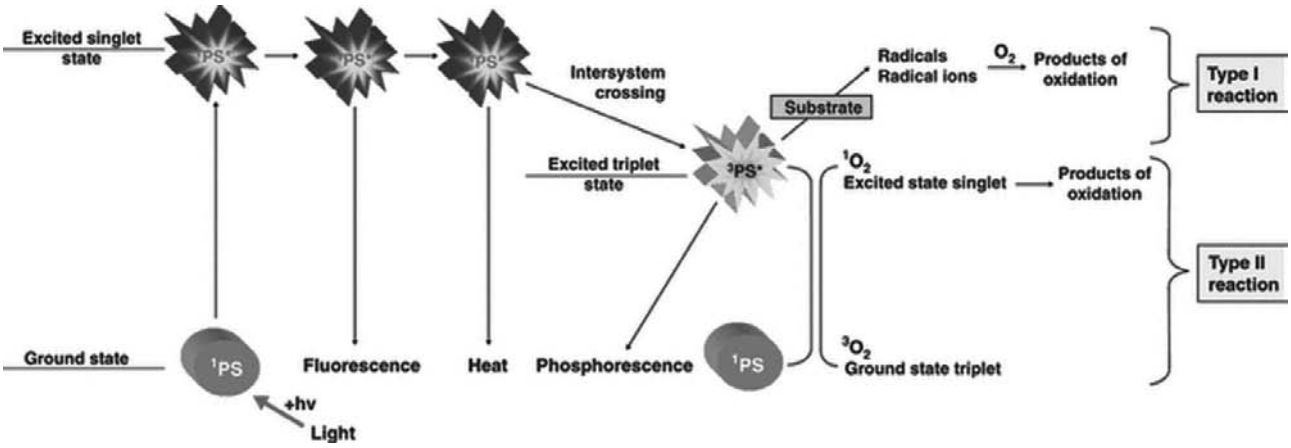
PDT in treatment of oral diseases

Application of PDT has led to significant advances in dentistry because the delivery of light is more accessible and topical application of the photosensitizer is more feasible in the oral cavity. PDT has been used in the treatment of different types of oral solid tumours, superficial pre-cancerous oral lesions like oral leukoplakia, erythroplakia, verrucous hyperplasia and lichen planus. Due to its antimicrobial property, it is potentially used in treatment of bacterial, viral and fungal infections of oral cavity. In operative dentistry, it is effective for the prevention and treatment of dental caries by eliminating bacteria in softened carious dentin. In endodontics, it is effective as an adjunct to conventional endodontic disinfection treatment to destroy bacteria that remain even after irrigation with sodium hypochlorite. In periodontics, it is used in periodontal and peri-implant therapy.

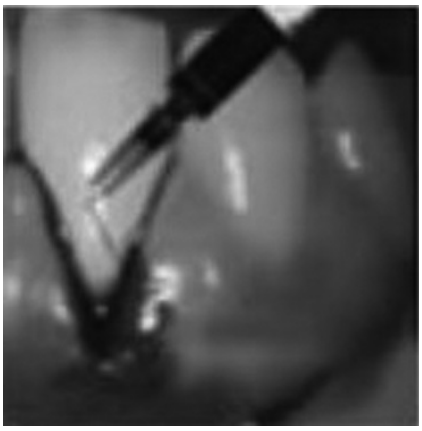
Antimicrobial photosensitizing agents and the wavelengths used in periodontal and peri-implant therapy

In aPDT, the particular photosensitizers employed are:

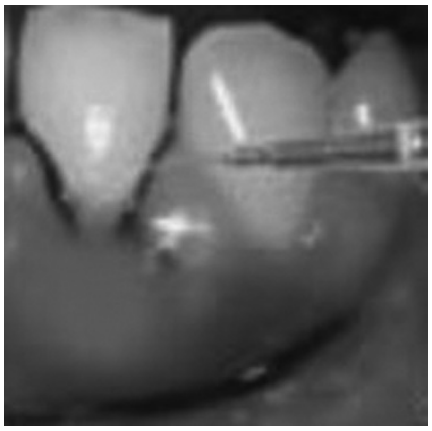
- Toluidine blue O
- Methylene blue
- Erythrosine
- Chlorine e 6 and
- Hematoporphyrin



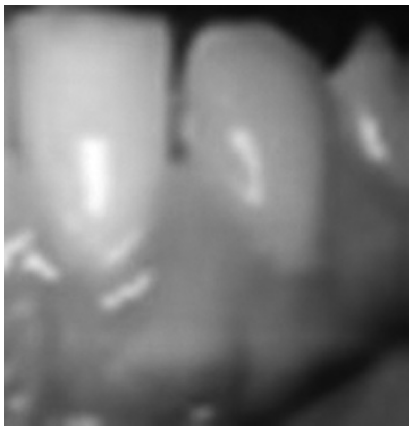
PDT in treatment of periodontitis



Application of dye



Application of light



Post treatment view

Of these, the phenothiazine dyes (toluidine blue O and methylene blue) are the major photosensitizers applied clinically and they are effective against both gram positive and gram negative bacteria. Gram negative seems to be more resistant to PDT than gram positive due to their difference in outer membrane structures.

In the past, the light sources used were argon lasers, potassium titanyl phosphate, Nd:YAG lasers. Currently used specific wavelengths are those of helium-neon lasers (633nm), gallium-aluminium-arsenide diode lasers (630-690, 830 or 906 nm) and argon lasers (488-514nm). Recently, non laser light sources, such as light emitting diodes (LED) are used as new light activators in PDT. They are more compact, portable and the cost is much lower.

Risks and side effects of aPDT

Its classified into two categories:

- Effects of light energy
- Effect of photosensitizer and the photochemical reaction

Regarding the light source, some rules and concerns should be kept in mind:

1. Use of protective glasses by the patient, operator and assistant to avoid inadvertent irradiation of the eyes.
2. During treatment with lasers, thermogenesis occur and hence an extended period of irradiation at the same spot must be avoided.

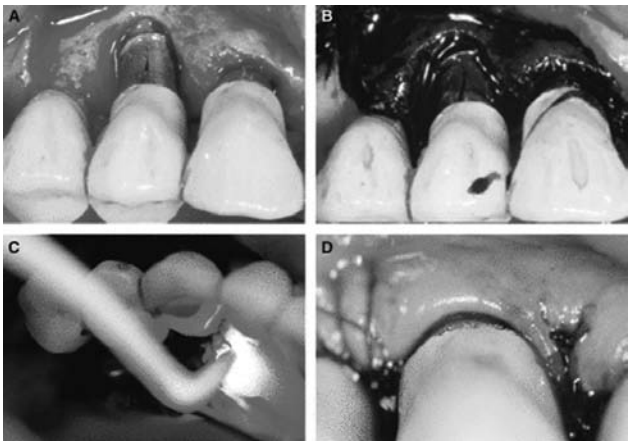
Regarding the use of photosensitizer:

1. It may be toxic to some extent. Most of the dyes adhere strongly to soft tissues. Thus retention of dyes in the pocket may affect periodontal tissue attachment during wound healing.
2. Use of photosensitizer can compromise patient esthetics by producing temporary pigmentation of the periodontal tissue.

Current status and future directions

Antimicrobial PDT seems to be an attractive option as a low cost treatment approach because it can be applied locally and systemic antibiotics can be avoided in localized infection. However, it has not been classified which photosensitizer and light source would provide

PDT in treatment of peri-implantitis



A – Case of peri-implantitis **B –** Application of dye
C – Application of light **D –** Post treatment view

most suitable combination to obtain the desired bacterial effects. Moreover, the optimal time of photosensitizer application as well as time of light exposure required are unknown. There is no study comparing the antimicrobial effects of aPDT with that of local and systemic antibiotics. Thus it is unclear whether aPDT can be used as an alternative for systemic or local antibiotics. Moreover, it has not been demonstrated whether PDT can completely eliminate the periodontal pathogens from humans.

Conclusion

Antimicrobial photodynamic therapy seems to be a unique and interesting therapeutic approach towards the treatment of periodontitis and peri-implantitis. However, sufficient clinical and microbiological data that support the superior effects of the adjunctive use of PDT has not been demonstrated. Therefore, further in-vivo and clinical studies are necessary to determine the optimal condition of this novel therapy. Antimicrobial PDT may hold promise as a substitute for currently available chemotherapy in the treatment of periodontal and peri-implant disease.

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Craniofacial distraction: An orthodontic perspective

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Abstract

Management of patients with skeletal deformities in the maxillofacial region remains an important challenge for medicine and dentistry throughout their evolution as health care sciences. Distraction osteogenesis (DO) is a surgical technique that uses the human body's own repairing machinery as an ally for tissue reconstruction under a controlled approach. Congenital or acquired, these deformities are invariably associated with disabilities or compromised esthetics, therefore demanding a carefully designed surgical and orthodontic treatment plan. This article is aimed at providing an insight into the current trends in craniofacial distraction with particular emphasis on orthodontic management. This will also briefly outline the biomechanical and biological aspects of craniofacial distraction along with potential areas of failures and methods to prevent it.

Introduction

Distraction Osteogenesis (DO) is the regeneration of bone between vascularised bone surfaces that are gradually separated by distraction.[1] Since its introduction, it has gained wide spread recognition in Orthopedic surgery as an effective means of bone Lengthening, deformity correction and filling large diaphyseal defects. DO was used as early as 1905 by Codivilla[2,3] and later popularized by Ilizarov.[3,4] Initially applied in maxillofacial region for mandibular dysplasia's, the technique is now applied throughout the entire craniofacial complex. McCarthy JG[3] (1992) opened new horizons with the publication of the first application of Distraction Osteogenesis in human craniofacial skeleton.

Although this technique can generate unlimited amounts of bone, bilateral mandibular distraction is very difficult to control and can result in excessive lengthening. The *sin qua non* of integrated orthodontic and surgical plan are essential to ensure successful treatment outcome and favorable inter-disciplinary interactions.[7] Distraction Osteogenesis is developing into a treatment modality in the orthodontist and surgeons armamentarium and one cannot help but be impressed by the versality of its application. This article is aimed at providing an insight into the current trends in craniofacial distraction with particular emphasis on orthodontic management. This will also briefly outline the biomechanical and biological aspects of craniofacial distraction along with potential areas of failures and methods to prevent it.

Principles of Distraction Osteogenesis

Ilizarov, described the basic principles of DO under four main areas such as[4,8,9] bone cut, latency period, rate, rhythm and consolidation period. Bone Cut is performed initially to create a corticotomy in the deficient mandible and can be converted into an osteotomy at a later stage. After the bone cut, on an average, a 5-day latency period is observed before device activation. This allows for the formation of an adequate fibro vascular bridge between the bone edges. Clinically the latency period may be shortened for 1—2 days if the patient is young. For adult patient a full latency period is recommended. For a young child, the rate of distraction may increase up to 1.5 to 2.0 mm per day and for adults the rate should be reduced to 0.5 to 1.0 mm per day.

Continuous application of distraction force is ideal. Clinical application of the distraction is best performed by activating the device twice a day (0.5 mm twice a day for a total of 1.0 mm every day). If the patient experiences discomfort during the distraction process, then the rhythm should be altered to allow for a smaller incremental application of the distraction force (e.g. 0.25 mm four times a day for a total of 1.0 mm per day). Once the regenerate has been created, the distraction device is held in neutral fixation, allowing the neo-mandible to ossify. The timing of the ossification process is similar to that of fracture healing (6—8 weeks).

Types of distraction [7,8,9,10]

The Various types of craniofacial DO's[9,10] are categorized as mandibular DO, mid face DO and others (Table 1). The distraction devices are of extra oral and intra oral types. The extra oral DO devices are of unidirectional, bidirectional and multidirectional, the benefits of which includes[9,11,12] unsurpassed three dimensional (3D) control during distraction; the ability

Table 1. *Various types of craniofacial distraction osteogenesis*

Mandibular distraction Osteogenesis	*Mid face*	*Others*
1. Internal Distraction	1. Lefort I	1.Fronto Orbital distraction
2. External Distraction	2. Lefort II	2.Cranial distraction
Single vector	3. Lefort III	3. Zygoma distraction
Multiple vectors	4. Alveolar ridge distraction	
3.Transverse Mandibular	5. Palatal Distraction	
Distraction Osteogenesis		

to alter the distraction vector during the process; and the avoidance of major re-surgery for device removal. The major drawbacks are: skin scarring caused by translation pins fixations, pin loosening, the need for patient compliance during the consolidation phase; and intracranial pin migration, either accidental or gradual.

The Intra oral devices[9, 11,12] are of tooth borne, bone borne and hybrid. The benefits of internal devices include: elimination of skin scarring, improved patient compliance and improved stability of the attachment of the device to the bone. The major drawbacks are: the need for precise positioning of the device, difficulty in alignment between the two sides and the angulations, which can be challenging in patients with numerous previous operations and subsequent cranial thinning or deficiencies; the inability to alter the distraction vector during the distraction process; and the need for a second major operation to remove the device. Cheng Wang Et al[39] in 2010 used a completely internal device made of a nickel-titanium shape memory alloy (Ni-Ti SMA) spring has been developed and applied successfully in animal models. Although it is a feasible method of repairing bone defects, improvements are needed to better control the distraction process and enhance the quality of regenerated bone.

Planning the vectors of distraction Osteogenesis

The successful application of distraction technique depends on biologic and biomechanical factors.[13,14,15] The biologic factors include the maximum preservation of soft tissues and blood supply during osteotomy, an adequate duration of the latency period, an optimum rate and duration of distraction and sufficient time for the remodeling of the new bone.

The Biomechanical factors are categorized in to

1. Extrinsic or fixator related
2. Intrinsic or tissue related
3. Device Orientation

The Extrinsic parameters includes the number, length, and diameter of pin fixations, the rigidity of distraction mechanism, and the material of the device.[14] The Intrinsic parameters include the geometric shape, cross-sectional area, and density of distracted bone segments, the length of distraction regenerate as well as the tension of the soft tissue envelope.[14] Device placement can be grouped into three orientations such as vertical, horizontal and oblique based on relationship to the long axis of mandibular body. The position of the distraction device directly influences the skeletal morphology.

Distraction osteogenesis begins with the development of a reparative callus.[15] The callus is placed under a stretching force, which generates new bone. DO consists of three sequential periods. Latency period from bone division to the onset of traction, represents the time allowed for callus formation. The histological sequence during the latency period is similar to that seen during fracture healing. It consists of four stages or phases[15] (1) inflammation, (2) soft callus, (3) hard callus, (4) remodeling. The period of distraction, when gradual traction is applied and new bone or distraction regenerate is formed. During this period the normal process of fracture healing is interrupted by the application of gradual traction to the soft callus. According to James Arson[16] at the beginning of this phase the local histology is transformed from mixed endochondral intramembranous ossification (reparative response) to well organized longitudinal intra membranous ossification (a regenerative response). Consolidation period allows maturation and corticalization of regenerate after traction forces are discontinued. After the distraction ceases, the fibrous interzone gradually ossifies and one distant zone of woven bone completely bridges the gap. The Various advantages and disadvantages of distraction osteogenesis are given in Table 2.[6,8,11]

Patient Evaluation and Treatment Planning

Distraction requires very precise treatment planning and surgical execution. Subtle variation in the position of the Osteotomy or in the position of the distraction device will affect the ultimate position of the tooth-bearing segment. In order to accomplish this a through preoperative clinical evaluation of the patient is undertaken similar to the examination carried out for

Table 2. *Advantages and disadvantages of distraction osteogenesis*

Advantages of DO	*Disadvantages of DO*
♦ DO will Lengthen bone and soft tissue ♦ Good long term stability ♦ Potential for growth in children ♦ Low infection rate ♦ Short Hospital stay and hence less costly ♦ Avoidance of bone grafts ♦ Distraction of bone-graft can start as early as 2 years of age ♦ Less invasive and hence less operating time ♦ Lesser number of postoperative complications ♦ No donor site morbidity, ♦ Reduced post operative swelling and pain ♦ Reduced need for intermaxillary fixation	♦ Extra Oral DO Produces Skin scars ♦ Damaging to VII nerve ♦ Damage to tooth germ ♦ Bilateral coronoid ankylosis ♦ Tendency toward clockwise rotation ♦ Multiple daily Out patient visits ♦ Poor Three dimensional control ♦ Increased post operative pain ♦ Difficult access to Orthodontist because the distracters obscure the buccal segment ♦ Difficult plaque control ♦ Damage to TMJ due to incorrect vectorization leads to flaring of gonial angle and malposition of condyle head

orthognathic surgery[18] this is usually performed with model surgery is to accurately simulate the patient's facial structures both functionally and spatially. The basic reason to perform the model surgery is to determine, if the indicated distraction procedure will produce an occlusion that can be perfected by subsequent orthodontic treatment. If such an occlusion cannot be produced, the orthodontist should determine what must be done orthodontically before surgery. The model surgery[19] is done not only before developing a definite treatment plan, but also during pre surgical orthodontic treatment when the orthodontist believes that the pre surgical orthodontic goals have been achieved. The models are mounted on the anatomical articulator[20] using arbitrary face bow transfer and prediction model surgery is performed on the mounted models

Orthodontic Management of Distraction Osteogenesis

In order to achieve the goals of esthetics, function and stability, the orthodontist must understand and plan as carefully as possible, the direction in which the tooth bearing segment will travel during distraction, in concert with the maxillofacial surgeon.[50] Further the orthodontist[50] must be able to modify the position of the tooth-bearing segment by exerting orthopedic and orthodontic forces by making adjustments to the distraction device.

The orthodontic treatment during DO falls into three temporal phases[22]

1. Pre-Distraction Orthodontic/Orthopedic Preparation[20,21,22,23]
2. Orthodontic /Orthopedic therapy during distraction and Consolidation period[25]
3. Post consolidation Orthodontic and Orthopedic management[21,22,23,26,27,28]

1. Pre Distraction Orthodontic Preparation[20,21,22,23]

When the patient is young or with deciduous dentition, the pre-distraction orthodontics may not be indicated. In the mixed dentition stage,[23] a series of orthopedic appliances are used to progressively reposition the mandible vertically and transversely into normal position. It has positive effects on the facial appearance and neuromuscular function and stretches deficient soft tissues before the surgery.

When the permanent dentition is fully erupted in adults the predistraction orthodontics is carried out with specific objectives so that the natural compensations are eliminated[20,21,22,23]

♦ Intra-arch objectives[20,21] includes elimination of dental mal relationships that would mechanically interfere with the movement of the tooth bearing segments during the gradual distraction. Even after the orthodontic treatment, the persisting interferences may be overcome by using biteplane or biteblock appliances.

♦ *Antero-posterior (sagittal) objectives*[20,21,27]

Antero-posteriorly, the commonly observed dental compensations include very protrusive mandibular incisors and upright maxillary incisors. "Reverse orthodontics" instead of conventional orthodontic treatment in adults, often aimed at further decompensating the malocclusions are performed. The main objectives include positioning the incisors in axial relationships that are as "ideal" as possible and when the surgical procedures are carried out, the jaws can be correctly positioned with minimal interferences from the occlusion.

♦ Transverse objectives[20,21, 22,27]

In patients with severe transverse deficiency, it is

appropriate to expand the maxilla, either before or during distraction to accommodate the width of advanced mandible. Dental position and maxillary arch width should enhance the distraction, not to inhibit it.

- Vertical objectives[22,26,27]

The two principal objectives of orthodontic mechanics in the vertical plane prior to surgery are the avoidance of adverse dental relapse potential and the maximizing of the speed and efficiency of treatment. Maximizing presurgical orthodontics will lead to minimal post surgical mechanics (with its inherent bite-opening tendencies) being required. Where anchorage requirements dictate the use of a headgear, care should be taken when a high-pull headgear is used, as any resultant intrusion of the maxillary molars may tend to rebound, after surgery. Any postsurgical extrusion of the maxillary molars may lead to the return of an open bite. In those patients who exhibit a deep bite tendency the major portion of the orthodontic mechanics, should be postponed until after the surgery.

Pre Distraction Stabilization appliances[22,23]

The interarch distraction stabilization appliances are inserted before surgery inorder to facilitate vector control by maintaining mediolateral dental interarch relationships. This will prevent lateral shifting of the tooth bearing segment during the active phase of distraction. These appliances may be used for patients who do not require specific tooth movement before distraction, are not in full orthodontic bands and brackets, are very young, have limited compliance, may have limited tooth present or may require maximum segment anchorage. They will provide multiple opportunities for the use of interarch elastics to control mandibular position during distraction, consolidation and post consolidation phases.

Once the presurgical orthodontic treatment is completed, the orthodontist should take a complete set of presurgical records consisting of accurate models (for simulating model surgery and for splint fabrication), a centric relation recording, a face-bow transfer and mounting where indicated, a cephalometric head film in centric relation, and facial as well as intraoral photographs.

Tehranchi and Behnia,2000; Takashima et al., 2003; Shetye et al., 2006,[23] suggest that the addition of an orthodontic treatment or an orthopaedic plate will significantly improve the stability of the results. The protocol adapted are over 10 months of functional therapy prior to distraction and 12 months post-distraction. They advocated the use of an asymmetric intraoral appliance (Harvold, 1975) a modified expansion screw activator,[23] with an occlusal stop on the unaffected side, completely free occlusally on the affected side in order to allow for dento-alveolar elongation. The appliance was worn during the whole period of distraction, during the skeletal retention period, and then for another 12 to 14 months. Orthopaedic treatment associated with DO allows only a delay in the recurrence of the occlusal cant and functional treatment decreases the relative height of the mandibular body on the affected side, making final surgical planning slightly more complex. There fore the decision to apply an orthopaedic treatment in addition with distraction should be taken by the surgeon and orthodontist together, selecting suitable candidates, considering both the advantages and the disadvantages of this treatment.

2. Orthodontic therapy during distraction Phase [22,23,24,27]

Active orthodontics and orthopedics may be continued throughout the distraction phase. This includes the use of bands, brackets, distraction stabilization appliances, elastics, headgear, acrylic guidance appliances, maxillary expansion appliances, functional appliances, passive rectangular arch wires and surgical hooks for the use of intermaxillary guiding elastics during the active stage of distractions. The use of these appliances improves the quality of orthodontic/surgical result by directing the tooth-bearing segment towards its planned post distraction position. The clockwise rotation of tooth bearing segment during active distraction is achieved through a combination of angular adjustment of distraction device along with anterior vertical elastic traction. Under these circumstances the openbite will close through a combination of counter clockwise skeletal rotation and dentoalveolar extrusion.

3. Post Consolidation Orthodontic and Orthopaedic management[22,23,24,27]

After consolidation, the distraction device is removed and the tooth-bearing segment of the mandible then derives its support from the new bone that was generated across distraction gap. Post-distraction Orthodontics/Orthopedics is instituted at this time to accomplish the occlusal goals. In unilateral distraction cases, the orthodontist is often confronted with a posterior openbite on the distracted side and a crossbite on contra lateral side. The open bite is managed with gradual adjustment of bite plates by selective eruption of maxillary dentition. The cross bite resulting from mandibular shift across the mid sagittal plane may be corrected by a combination of transpalatal arches, lingual arches, intermaxillary cross elastics, and a palatal expansion devices.

A minimum of 5 to 6 months of postsurgical Orthodontic treatment should be required. Lengthy postsurgical orthodontic treatment can lead to compromises in stability and function, if the surgical results are disrupted. It is vital to customize the patient's retention plan according to the characteristics of the

original Problem and the features of any relapse patterns seen after surgery.

Effect of distraction osteogenesis on soft tissues and hard tissues[33,34]

Hard tissues

The clinical results of distraction of the craniofacial region have been illustrated qualitatively by the improvement in facial symmetry, appearance, and improvement in dental occlusion. As according to Joseph G McCarthy[1] the condyle assumes a more normal anatomic size and shape position in the TMJ after Distraction Osteogenesis. Bazita Tehranch *et al,*[29] found that the piriform angle, the intergonial angle, and the cant of occlusal plane were improved after the DO.

Soft tissue changes or distraction histogenesis[34]

During the distraction procedure adaptive changes that occur in the soft tissues are known as distraction histogenesis. Cornelius Klien et al[30] Stated that after DO an increase in soft tissues, mainly the masticatory muscles and motor nerves on the affected side was observed. lizarov[29] reported an associated lengthening of attached muscles and nerves after gradual distraction of bones of extremities. Reha S.Kisnischi et al[29] could observe the mechanical deformation that the inferior alveolar nerve undergoes, together with impairment of venous blood flow, especially after certain amount of stretch. Guerrissi et al noticed an increase in metabolic and bio-synthesis activities in muscle tissue after distraction

Cellular level

The ultra structural level changes that occur after Distraction Osteogenesis depends on the rate and the type of stress applied. Ilizarov[31] reported that Distraction Osteogenesis is associated with intense angiogenic activity, which is reflected on the newly, formed capillaries along the direction of distraction vector. Franciso J Castano[32] stated that the distraction of mandible at a rate of 1 mm/day induced less myocyte proliferation rather than faster rates of distraction (2 to 4 mm / day). The distraction operative procedure leads to inverse changes in serum concentrations of TGFB1 and IGF-1 thereby promoting the recruitment of osteoblastic precursor cells as well as collagen matrix synthesis. Holbein[31] demonstrated sera of patients with Distraction Osteogenesis have mitogenic effect on osteoblastic cells. He also showed an increase in TGF and PDGF. Other studies confirmed the presence of constituents of vascular basement membrane (laminin, typeVI collagen) both at the site of DO and at the interference area of transported bone and the target bone.

Retention and relapse after distraction osteogenesis[35,36]

The main reason attributed to relapse includes delayed post distraction orthodontic treatment, Premature removal of device before complete ossification leading to collapse of the regenerate bone, distraction by a tooth borne device can result in greater expansion of the teeth as compared to the basal bone resulting in dental relapse potential and due to condylar resorption.[75]

Post distraction, orthodontic care continues, with most patients wearing bionator[23,35] therapy or any other functional appliance for a maximum of 6 months as the bone regenerate continues to ossify. Various retention means are employed to prevent relapse tendencies post-orthodontically. A maxillary circumferential Hawley retainer and a mandibular extended retainer can be worn 24 hours a day for the first 3 months and every night for the next one year. Sometimes a permanent lingual retainer can be given on lower arch. Bite planes can also be inserted at the removal of the distraction device in order to guide proper eruption and oppose any forces of relapse. The use of 'vario plates[35] a kind of removable retention appliance or inter arch force modules such as Jasper Jumper has been tried by various researchers for the purpose of retention. In congenital mandibular deformities at the end of distraction process, orthodontic elastics can be used to help guide and mold the regenerate to its proper shape and position.

Failures in Distraction Osteogenesis[16]

DO can fail in least four ways such as ishemic fibrogenesis, cystic degeneration, fibrocartilage non-union, late buckling, bending or fracture of regenerate bone. Ischemic fibrogenesis (with failure of mineralization) occurs due to inadequate blood supply during distraction. Although fibrous tissue forms in the gap, it appears loose and bone columns do not form from the avascular host bone surfaces. Cystic degeneration occurs due to blockage of venous outflow from the system. The large vascular channels contain a fluid more like lymph than blood, and the distraction gap is filled either completely, or in part a cyst like fluid.

Fibrocartilage nonunion occurs usually with unstable external fixation where micro fractures, hemorrhage and cartilage interposition occurs. Buckling or bending of regenerate bone occurs when the fixation device is destabilized or removed prematurely.

Future of Distraction Osteogenesis[37]

The future development of osteodistraction for craniofacial applications will probably establish a more complete understanding of the biology of new bone formation under the influence of gradual traction. Major trends may include distraction protocol refinements,[37] improvements in osteotomy techniques, development of a multidirectional intraoral distraction devices with the capability of linear and angular adjustments.

Conclusions

For several decades, non surgical DO has been performed by the orthodontic fraternity in the form of rapid palatal expansion. Although the technique was developed by Dr.Ilizarov, it was Joseph G McCarthy who developed the technique for distracting the craniofacial skeleton. Numerous indigenous applications ranging from the vertical increase of alveolar bone height to transport distraction have been developed. A multitude of appliances, ranging from large extraoral appliances, minute intraoral devices[38,39] and even resorbable devices have also been designed. The application of osteodistraction offers novel solutions for surgical orthodontic management of developmental anomalies of the craniofacial skeleton.

DO is developing into an important treatment and one cannot help but be impressed by the versatility of its application. Powerful research, accurate recording of clinical data and critical analysis of distraction results will enable us to further refine this science into a treatment method to achieve predictable, functional, aesthetic and stable outcomes.

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Case report

Application of platelet-rich fibrin for periodontal hard and soft tissue regeneration

* Nisha K.J.

Abstract

Platelet-rich fibrin (PRF) represents a new step in the platelet gel therapeutic concept. Clinical data show that this biomaterial would be a favorable matrix for the development of a coherent healing without inflammatory excess. The ease of preparation, lack of biochemical handling of blood and sustained release of growth factors make it a promising autogenous graft material for periodontal hard and soft tissue regeneration. This article provides a summary on the technique of procurement of PRF; its advantages over the first-generation platelet concentrate platelet-rich plasma (PRP), various clinical applications and the factors to be taken care of while handling this material.

Introduction

An important objective of periodontal regenerative therapy has been predictable formation of a new attachment apparatus including bone, cementum and periodontal ligament. Multiple approaches have been used in an effort to achieve this goal including, demineralized freeze-dried bone allografts, bovine-derived xenografts, barrier membranes, and combinations of membranes and bone grafts. Though these regenerative materials are still used today, the introduction of biologic modifiers such as enamel matrix derivatives, platelet rich plasma (PRP), recombinant proteins and bone morphogenic proteins have given new promise for better outcomes in treatment of periodontal defects.

Platelet-rich fibrin (PRF) belongs to a new generation of platelet concentrates, with simplified processing and without biochemical blood handling. Considering that PRF may enhance the healing potential of bone as well as soft tissues, its application for periodontal soft and hard tissue regeneration holds much promise.

Evolution of Platelet-rich fibrin as a bioactive surgical additive

The development of a bioactive surgical additive, which regulates inflammation and improves healing, has been one of the greatest challenges facing clinical research. Keeping this purpose in mind, various surgical additives were developed. The first one to develop in this category was fibrin adhesives or fibrin glue. Although the use of fibrin adhesives in many field-related protocols is well documented, it remained controversial owing to the complexity of the production protocols or risk of cross-infection and many of the marketed fibrin adhesives were withdrawn. Later in 1997, the use of platelet concentrates based on the concept of cell therapy by growth factors was introduced. The development of platelet concentrate technologies offered simplified and optimized production protocols for a new kind of fibrin adhesive, concentrated platelet-rich plasma (cPRP). But in countries like France, where there were legal restrictions on blood handling, a new family of platelet concentrate, which is neither fibrin glue nor a classical platelet concentrate, was developed. This new biomaterial was called platelet-rich fibrin (PRF).[1]

Platelet Rich Plasma

Platelet rich plasma (PRP) is an autologous concentrate of human platelets in a small volume of plasma. It is a simple strategy to concentrate platelets or enrich natural blood clot, to initiate a more rapid and complete healing process. A natural blood clot contains 95% RBCs, 5% platelets, where as a PRP blood clot contains 4% RBCs, 95% platelets. The technique of procurement of cPRP is as follows.[2] 10 ml of blood is collected from the patient and mixed with anti-coagulant to avoid platelet activation and degranulation. The blood is then subjected to a first centrifugation ("soft spin") at 1300rpm for 10 minutes to separate it into three layers – bottom layer of red blood corpuscles, top most layer of acellular plasma layer designated as platelet poor plasma (PPP) and an intermediate layer where platelet concentration is largely increased. The PRP and PPP layers are aspirated using a sterile syringe and transferred to another tube. This is again centrifuged at 2000rpm for 10 minutes ("hard spin") to separate the top PPP and bottom cellular layer. With a syringe, discard the major part of the PPP. The cPRP thus obtained is then activated with calcified thrombin (0.1ml of 10% CaCl2 and bovine thrombin in 7:1 ratio). Within 5 to 30 seconds

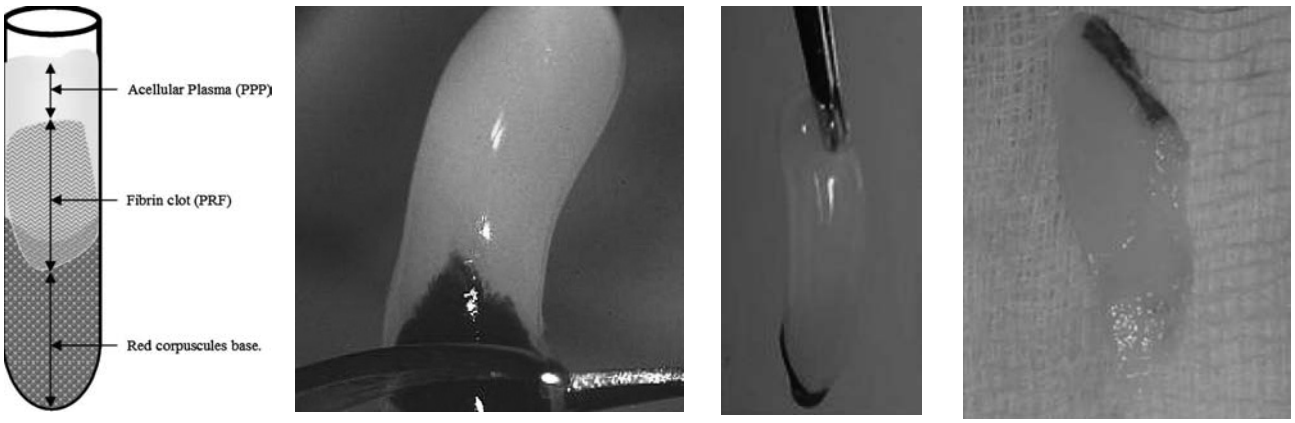

Fig 1 (a-d). Steps in preparation of PRF membrane

the solution will assume a gel-like consistency forming platelet gel. The use of bovine thrombin may be associated with the development of antibodies to the factors V, XI and thrombin which can lead on to serious coagulopathies.

Platelet rich fibrin

Platelet-rich fibrin (PRF) was first developed in France by Choukroun et al in 2000 for specific use in oral and maxillofacial surgery. Produced in a totally natural manner, PRF doesn't require use of an anticoagulant during blood harvesting or bovine thrombin or calcium chloride for platelet activation and fibrin polymerization. It is nothing more than centrifuged blood without any addition, which makes it possible to avoid all the restrictions of the French law related to blood-derived product re-implantation.

Advantages of PRF when compared to PRP

- Simplified processing
- Reduced biochemical handling of blood
- Reduced risks associated with the use of bovine-derived thrombin.
- Better handling characteristics

Preparation of PRF

The PRF protocol is very simple. The required quantity of venous blood is drawn into 10ml test tubes without an anticoagulant. The blood is centrifuged immediately using a tabletop centrifuge for 10 min at 3000 rpm. The resultant product consists of the following three layers (Fig. 1 a).

1. Topmost layer consisting of acellular PPP
2. Fibrin clot in the middle
3. RBCs at the bottom

The fibrin clot is easily separated from the lower part of the centrifuged blood (Fig 1 b&c). The platelet-rich fibrin clot is gently pressed between two layers of sterile dry gauze to form a membrane (Fig 1 d).

Factors to be considered during procurement of PRF

- Platelets and leukocytes are concentrated in the lower part of the fibrin clot, mainly at the junction between the red corpuscles (red thrombus) and the PRF clot itself.[2,3] Therefore, the PRF - red extremity would be of interest for clinical use.
- Speedy blood collection and immediate centrifugation, before the clotting cascade is initiated, is absolutely essential to obtain a clinically usable PRF clot. Coagulation of the blood sample starts almost immediately upon contact with the tube glass. Overly long duration between blood collection and centrifugation will cause diffuse polymerization of fibrin and only a small blood clot without consistency will be obtained.[1]

Biologic effects of PRF

PRF is a fibrin biomaterial with a specific composition, 3-D architecture and associated biology. It is classified as a leukocyte- and platelet-rich fibrin biomaterial.[4] Platelets release growth factors like platelet-derived growth factor A&B, transforming growth factor-b1, insulin-like growth factor-1&2, vascular endothelial growth factor, etc that aid in recruitment and differentiation of stem cells in a tissue repair site. These growth factors also aid in angiogenesis and stimulate osteoblasts and fibroblasts. The leukocytes have got strong influence on growth factor release, immune regulation, anti-infectious activities and matrix remodeling during healing.

Comparison of properties between PRP and PRF

One of the major differences between PRF and PRP

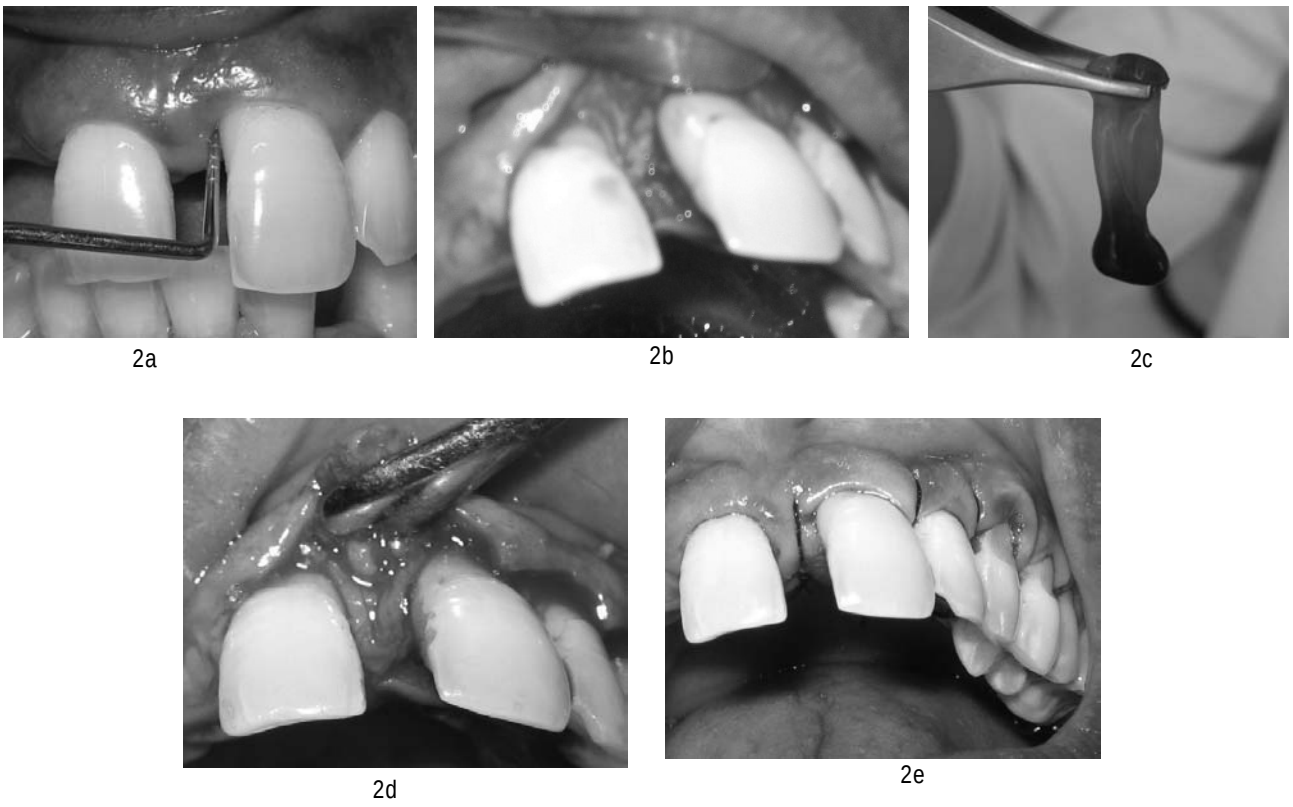

Fig 2 (a-e). (a)-site showing deep periodontal pocket (b) – angular defect mesial to left central incisor exposed (c) – PRF prepared (d) – PRF membrane kept in the defect (e) – surgical site sutured

is its gelling mode.[1] cPRP uses bovine thrombin and calcium chloride association to commence the last stages of coagulation and sudden fibrin polymerization. This mode of polymerization will considerably influence the mechanical and biologic properties of the final fibrin matrix. PRF has the characteristic of polymerizing naturally and slowly during centrifugation. The thrombin concentrations acting on the collected autologous fibrinogen are almost physiologic because there is no bovine thrombin addition. This aspect is crucial to determine the 3-dimensional organization of a fibrin network.

The slow and natural fibrin polymerization in PRF results in intrinsic incorporation of platelet growth factors and glycanic chains in the fibrin meshes leading to their progressive release during fibrin matrix remodeling during ≥ 7 days. In PRP, massive release of growth factors from platelets occurs during the sudden fibrin polymerization and their action is extremely limited in time.

The sudden fibrin polymerization in fibrin adhesives and cPRP results in a rigid network, which is not very favorable to cytokine enmeshment and cellular migration. However, this property is appropriate to firmly seal biologic tissues. In contrast, the weak thrombin concentrations in PRF allow the establishment of a fine and flexible fibrin network able to support cytokines enmeshment and cellular migration. This result in increased life span of these cytokines, which are released and used only at the time of initial matrix remodeling. Moreover, this 3-dimensional organization will give great elasticity to the fibrin matrix and a physiologic architecture that is very favorable to the healing process is obtained. In conclusion, this biomaterial consists of an intimate assembly of cytokines, glycanic chains, and structural glycoproteins enmeshed within a slowly polymerized fibrin network.

Applications of PRF for periodontal regeneration

The clinical applications of PRF are primarily based on its ability to accelerate tissue cicatrization due to the development of effective neovascularization, accelerated wound closing with fast cictricial tissue remodeling and nearly total absence of infectious events.[3,4] Study conducted by Chung-Hung Tsai et al, 2009 has shown that PRF exhibits non-cytotoxic effects towards periodontally related cells.[5] PRF may modulate cell proliferation in a cell-type specific manner. Gingival fibroblasts, periodontal ligament cells and osteoblasts are up regulated and epithelial cells are down regulated by PRF, which is beneficial for periodontal regeneration.

The PRF membranes obtained by driving out the serum from PRF clot can be used for periodontal regeneration in the form of membrane itself or it can

be mixed with bone grafts. PRF is a living biomaterial and not a commercially available inert membrane. The preparation and conservation of the membrane are significant parameters in all clinical situations.[6]

While using PRF membranes for periodontal surgical procedures, care should be taken to use them as quickly as possible because they will become dehydrated. Dehydration can influence the growth factor content and the leukocytes in it may probably die there by influencing the structural characteristics of PRF matrix. Even if the membranes are stored in a refrigerator, there is every chance of bacterial contamination.

There are two principles to be followed in all periodontal surgeries using PRF membranes[6]:

1. Always ensure adequate matrix volume and core material homogeneity

2. Control the migration of the different tissue families on the wounded site

The first principle is that, to ensure adequate matrix volume, clinicians must always use at least two layers of PRF membranes. This is because these membranes are thin fibrin scaffolds, which might be quickly resorbed, in the gingival environment where vascularization is very efficient. Leukocytes and platelet aggregates are concentrated within one end of the membrane. Therefore, by using only one membrane per surgery, the root covering becomes biologically inhomogeneous. This can be avoided by placing at least two PRF layers in opposite direction, which allows the entire surgical surface of multiple adjacent recession type defects to have the same components i.e., platelets, leukocytes, fibronectin, and vitronectin.

The second principle is that, to control healing and remodeling, clinicians have to control the migration of the different tissue families on the wounded site because the first cells to colonize the wound will direct the organization of the final tissue. This means that PRF membranes must always slightly hang over the edge of the gingival collar. Here, PRF acts as a healing and interposition biomaterial. As a healing material, it will stimulate the gingival connective tissue on its whole surface with growth factors and impregnate the root surface with key matrix proteins for cell migration. Moreover, the fibrin matrix itself shows mechanical adhesive properties and biologic functions. It maintains the flap in a high and stable position, enhances neoangiogenesis, reduces necrosis and shrinkage of the flap, and, thus, guarantees maximal root covering. As interposition material, the PRF layers avoid the early invagination of the gingival epithelium. PRF membranes can be used as such in the form of membranes in areas of gingival recession[7] or periodontal osseous defects or it can be mixed with bone grafts and kept in the defects or a combination of these can also be tried (Fig 2a-e).

Healing of surgical sites following PRF application

The effects of platelet concentrates are very significant during the first days of healing.[8] PRF permits rapid angiogenesis and an easier remodeling of fibrin in a more resistant connective tissue thus accelerating wound closure and mucosal healing. There is significant diminution of pain and discomfort, due to fibrin bandage and growth factor release.

Conclusion

PRF can be considered as a healing biomaterial. The ease of preparation and handling, together with the ability of PRF to simultaneously support the various aspects of healing and soft tissue maturation gives promise for many future applications including plastic and bone surgeries. Further well-designed and properly controlled studies are needed to provide solid evidence for the impact of PRF on wound healing, soft tissue reconstruction and augmentation procedures.

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Case report

Oral sarcoidosis presenting as ranula

* Shiv Prasad Sharma, ** C.R. Sobhana, *** Heera R.

Abstract

A 26 year old female reported with an asymptomatic swelling of the floor of the mouth. Clinical diagnosis of ranula was made and excision of the ranula along with the involved sublingual gland was performed. The diagnosis of sarcoidosis was established by the histopathologic evidence of typical non-caseating granulomas. Oral lesions may be the first or the only sign of sarcoidosis in an otherwise healthy patient.

Introduction

Sarcoidosis is a granulomatous disease of undetermined origin. No specific cause has been identified. It affects multiple organs and tissues. Head and neck lesions of sarcoidosis are manifested in 10 to 15% of patients.

In the maxillofacial region the salivary glands are frequently involved. Oral lesions, usually painless swellings, may be seen. The most frequently affected sites reported include gingivae, lips, palate and buccal mucosa. As we will demonstrate in this case report, sarcoidosis should be included in the differential diagnosis of oral and perioral lesions.

Case report

A 26 year old female patient presented to the Department of Oral and Maxillofacial Surgery with the chief complaint of swelling in relation to floor of mouth. According to her the swelling was present since 4 days without any progressive enlargement. Her medical history was noncontributory.

On clinical examination there was a non-tender, bluish oval translucent swelling in relation to right floor of mouth of size approximately 2x1.5 cms. The regional lymph nodes were not palpable. Clinical diagnosis of ranula was made and enucleation along with excision of the involved sublingual salivary gland was planned and performed under local anesthesia.

Histopathologic examination showed numerous non-caseating epithelioid granulomas that consisted of histiocytes and Langhans' or foreign body multinucleated giant cells.

Since the histopathological findings were compatible with sarcoidosis, in order to confirm the diagnosis, we proceeded with laboratory tests that strongly support the diagnosis for sarcoidosis. The results were: serum angiotensin converting enzyme(ACE) 41.6U/L (normal value: 18-55 U/L), blood calcium 10mEq/L (normal value 9-11 mEq/L). The chest radiograph did not show any abnormality. Further investigation was negative for systemic organ involvement.

Discussion

Sarcoidosis rarely involves the oral cavity. In some cases, oral involvement is the first, or only, manifestation of the disease. Only 47 cases have been reported in the English literature involving buccal mucosa, tongue, lips, palate, floor of the mouth, mandible, and maxilla. In cases involving the floor of the mouth, ranula formation from the sublingual gland is the most common initial presentation.

In the present case ranula involving the floor of the mouth was the only finding. The diagnosis of sarcoidosis is established when clinical and radiographic findings are supported by histologic evidence of widespread non-caseating epitheloid granulomas, with the exclusion of known causes of granulomas. Hematologic findings are not diagnostic for sarcoidosis but can be used to monitor disease activity. Angiotensin-converting enzyme is not specific for the diagnosis of sarcoidosis but can be used to monitor disease activity, response to treatment, and recurrence.

Various diagnostic salivary biopsy sites have been suggested. Biopsy specimens of normal appearing palatal salivary glands are positive in 38% of patients with sarcoidosis, whereas labial gland biopsy specimens are positive in 36% to 58%. The parotid gland is positive in 93% of cases and may provide the most reliable site for histologic confirmation of disease.

The therapy of choice for sarcoidosis is corticosteroids. Intra-oral soft tissue lesions have been treated with surgical enucleation or steroid therapy without reported recurrence.

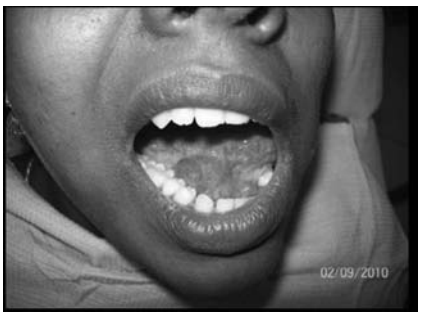

Fig 1. Clinically, patient presented with ranula involving floor of the mouth.

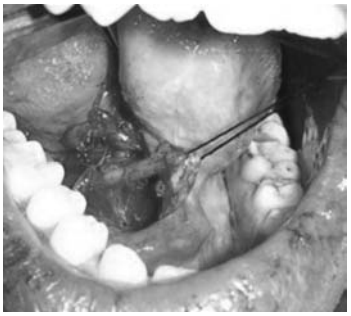

Fig 2. Intra-op view

Fig 3. Histopathologic slide picture showing scattered non-caseating epithelioid cell granulomas consisted of chronic inflammatory cells-histiocytes and Langhans' type multinucleated giant cells, some of which contained Schaumann bodies.(H-E. Original Magnification X 100).

Summary

Oral lesions may be the first or the only sign of sarcoidosis in an otherwise healthy patient. Reported oral involvement is rare. Prognosis of sarcoidosis correlates with mode of onset, initial clinical course, hosts' characteristics, and extent of disease. It is prudent for health-care providers to fully evaluate the systemic involvement of sarcoidosis in cases of suspected oral involvement. It is important to enforce a periodic follow-up of patients in order to evaluate the disease.

Conflict of Interest statement

There is no financial and personal relationships with other people or organisations that could inappropriately influence (bias) the work.

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Case report

Chondroblastic osteosarcoma of maxilla

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Abstract

Osteogenic sarcoma is one of the most common primary malignant tumors of long bones, the jaws being rarely affected. Even though the etiology is unknown, many pre-disposing factors are seen to initiate the condition. A case diagnosed as osteosarcoma of chondroblastic type is reported here.

Introduction

Osteogenic sarcoma is the most frequent primary malignant bone tumor, with the exception of multiple myeloma.[1] It can occur in patients ranging from young children to the elderly with a peak incidence of 27 years. The tumor shows a predilection for males. Both maxilla and mandible are involved with equal frequency.

Case presentation

A 27 year old male reported with complaint of a swelling in the palate since 3 months. He noticed a small swelling three months back, and it increased in size rapidly. The patient's medical history was unremarkable. There was no history of allergy and he had no deleterious habits. There was no relevant history of illnesses in the family. His review of systems was unremarkable.

Examination of palate revealed an erythematous swelling in the palate in the region of 4,5,6. The swelling was 3x3cm in size, non tender had a granular surface and was extending buccally, obliterating the sulcus in the region of 4,5,6. Submandibular lymph nodes were not palpable. Maxillary occlusal radiograph and panoramic view showed a mixed radiolucent radiopaque lesion in the region of left maxillary antrum with destruction of posterior margins.

CT scan showed progressive lesion involving the entire left maxilla with extension into the infra temporal fossa, alveolus, nasal cavity. Orbital floor was eroded, but contents were not involved. No neck nodes were seen.

An incisional biopsy was taken from palate, the histopathological report showed delicately collagenous stroma consisting of malignant mesenchymal cells which were severely dysplastic with large number of bizarre mitotic figures. Large areas of chondroid seen with minimal vascularity. The picture was suggestive of chondroblastic osteogenic sarcoma.

The patient was referred to Regional Cancer Centre, Trivandrum. He was admitted for surgery,and went for Neoadjuvant Chemotherapy as the lesion was advanced. Patient received 4 cycles of chemotherapy and was reassessed. The CT scan revealed no metastases. Case was discussed in tumor board and was decided for surgery of the border line operable tumor.

The procedure was total maxillectomy under general anaesthesia. Finding was that of a proliferative lesion involving whole of left maxilla extending medially into the (L) nasal cavity. The post-operative period was uneventful.

On microscopic examination, the section showed a neoplasm composed of lobules of cells in cartilagenous matrix separated by thick fibrocollagenous septae. Within the lobules oval/round cells with moderate eosinophilic cytoplasm and vesicular larger cells with abundant clear/vacuolated cytoplasm and vascular nucleus multinucleated cells were also noted. Pale eosinophilic matrix seen in between the cells. Dense areas of calcification noted. Also seen an area of fine calcification. Outer mucosal margins were free of neoplasm.

The diagnosis was chondroblastic osteosarcoma-High grade. On reviewing the patient 2 weeks after surgery, prosthetic consultation was done. The patient was more concerned about the appearance rather than function. After discussion it was decided to fabricate an intraoral maxillectomy obturator.

Prosthetic phase

1. An impression of the face was made in addition silicon putty. Stone cast was made. A custom tray was fabricated.

2. Border trimming was done and peripheral moulding was done using addition silicon putty. Light body was used to line the impression. Stone cast was poured.

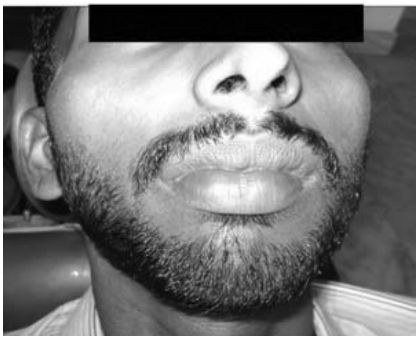

Fig 1. Extraoral photograph

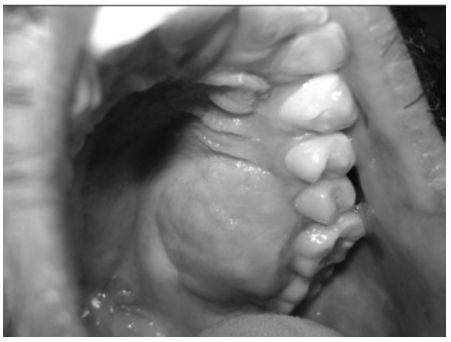

Fig 2. Intra oral photograph showing the lesion in the palate

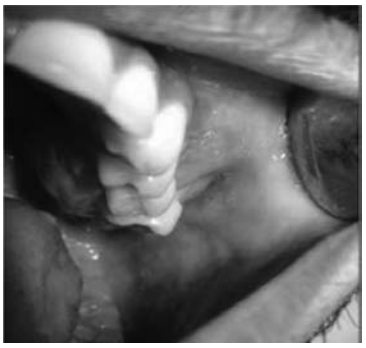

Fig 3. Buccal involvement of the lesion

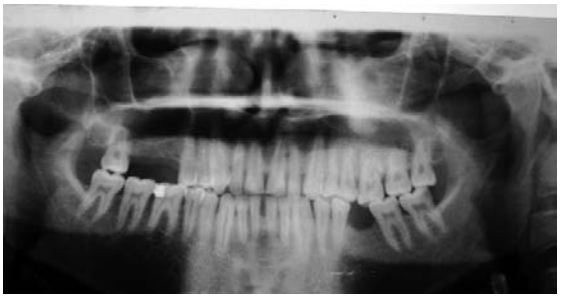

Fig 4. Panoramic view showing the lesion in the left maxillary antrum

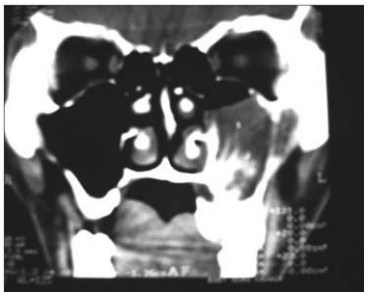

Fig 5. CT Scan showing the lesion in the left maxillary antrum

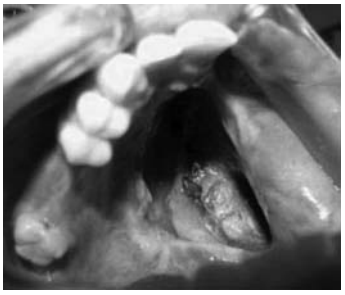

Fig 6. Post operative photograph

3. Using heat cure acrylic resin permanent denture was fabricated. Try in was done, restoring the teeth till canine. Since there were thick band of scar tissue on left side of cheek, it was dislodging the prosthesis. So we removed the canine.

4. Prosthesis was flasked and processed. Deflasking was done. Prosthesis was finished and inserted in place. To counteract the muscle pull, we had to reshape the lateral incisor. It gave a dentate appearance even though his aesthetic expectations were not fully satisfied. Patient was advised to come for a review after two weeks.

5. During review it was reported that, even though functionally it was quite satisfactory during phonation sometimes air leakage was there, through the margins. So we lined the prosthesis using a soft liner and this eliminated the problem.

The patient is now under regular follow up in Regional Cancer Centre, Trivandrum.

Discussion

Osteogenic sarcoma is the most frequent primary malignant bone tumor, with the exception of multiple myeloma[1]. However it is an extremely uncommon lesion occurring in only one per 1,00,000 persons per year.[2] Only 6-6.7% of all osteosarcomas occur in the jaw.[3] The pathogenesis of osteosarcoma is unknown. It is found that various predisposing factors including the presence of pre-existing lesions, such as bone-cysts[4], osteogenesis imperfecta[5], osteochondroma[6] and fibrous dysplasia as well as radiation of bone (with or without pre-existing bone lesions as in the treatment of Paget's disease[7]) or for treatment of keloids.[8] Other factors less often associated with this tumor are trauma,[9] genetic factors and viral agents.[10]

Osteosarcoma of the jaw most commonly occurs in the third decade of life. The tumor shows a predilection for males[11] when the jaws are involved about 5% affect the mandible, usually the body.[12] When the maxilla is affected the antrum and alveolar ridge are the most frequent sites. Other areas involved in the jaw include the palate, symphysis, ramus, angle of the mandible and Temporo-mandibular joint.[11]

The most common clinical signs and symptoms are initially, swelling of the affected region. Later on, pain, gingival bleeding, mobility and displacement of teeth and paraesthesia may be present.[13]

The radiographic appearance may vary- osteolytic, osteoblastic or mixed. The characteristic sunburst appearance of osteosarcoma is present only in 25% of the cases. The common radiographic findings in the jaw include widening of the periodontal ligaments and subperiosteal bone formation.

The histologic classification of osteosarcomas is based on the predominant type of stroma - osteoblastic, chondroblastic, fibroblastic, telangiectatic, fibrohistiocytic and juxtacortical tumors-parosteal, and periosteal.[14] The tumor is characterized by proliferation

Fig 7. Pretreatment photograph

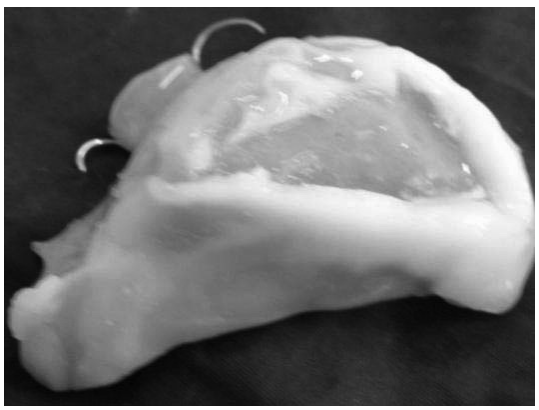

Fig 8. Obturator Fabricated

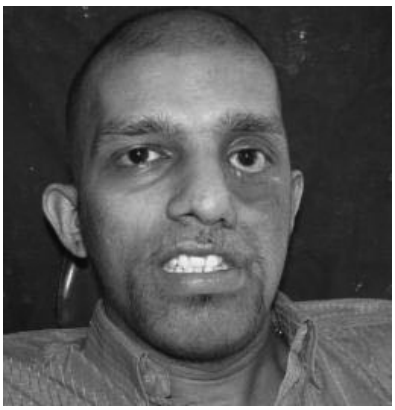

Fig. 9. Post treatment photograph

of osteoblast like cells that show pleomorphism, hyper chromatism and atypical mitotic activity[15]. Production of osteoid by malignant cells, even in small amounts is a diagnostic criterion of osteosarcoma.[16]

Several reports show that about 50% of the osteosarcomas of jaws are predominantly chondroblastic as in the case presented here.

Osteosarcomas of the jaw usually does not metastase. When metastases it occurs at distant sites involving the lung, cervical lymphnode, spinal cord and brain.[11]

Surgery is considered as the preferred treatment of osteosarcoma. Combined treatment by radiation surgery and chemotherapy has also been suggested. Newer protocols involve preoperative chemotherapy followed by radical surgical excision. In mandible hemimandibulectomy is recommended. For maxilla hemimaxillectomy or total maxillectomy is the surgical method. Radical neck dissection is indicated only in the presence of palpable cervical nodes.[17]

An overall five year survival rate has been reported for 15% of the cases. Osteogenic sarcoma in other bones is reportedly more virulent than the lesions in the jaws.[18] Gravanis and Whitesides stated that the only factor that influences the survival rate of patients with osteosarcoma is the average duration of symptoms prior to definitive diagnosis and treatment.[19]

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Gingival transplantation

*** K. Harikumar**

Abstract

The role of attached gingiva and its significance in maintaining periodontal health has been a topic of debate over many years. This article discusses the prevailing concepts regarding gingival dimensions and gingival augmentation on periodontal health. An attempt is made to derive possible conclusions based on consensus reports available in the literature till date. Gingival augmentation using various surgical techniques making use of soft tissue autograft transplants are demonstrated with predictable results.

Introduction

"To study the phenomenon of disease without books is to sail an uncharted sea, while to study books without patients is not to go to sea at all" — Sir William Osler (1849-1999) Prof of Medicine, Oxford, UK.

Evolution of new concepts is always promising and motivating to the researchers in the field of science. Periodontology has taken leaps and bounces right from its early conceptual years. One of the areas where emergence of challenging concepts raised extensive debate and dialogue was regarding dimensions of gingiva. A review of literature on this aspect still presents several unresolved issues regarding the dimensions of gingiva and its augmentation.

Concepts & controversies

Terminology

Mucogingival surgery, the term introduced by Friedman in 1950s was renamed as *Mucogingival therapy* in the Glossary of terms in Periodontology 2001. Currently the surgical procedures to correct defects of gingival or alveolar mucosa are called *Periodontal Plastic Surgery* proposed by Miller in 1993 and well defined in the proceedings of World Workshop of Periodontics in 1996.

Attached gingiva & periodontal health

Right from the period of Ainamo there were specific measurements for the amount of attached gingiva around different teeth. This was considered essential for oral hygiene maintenance, prevention of extension of marginal inflammation (tissue barrier concept – Cohen) and maintenance of periodontal heath. There were debates on the need for "adequate" zone, "sufficient" zone of attached gingiva. Literature at that times support this concept and showed that a reduced apicocoronal height lead to increased subgingival plaque, clinical attachment loss, gingival recession and difficulty in oral hygiene maintenance.

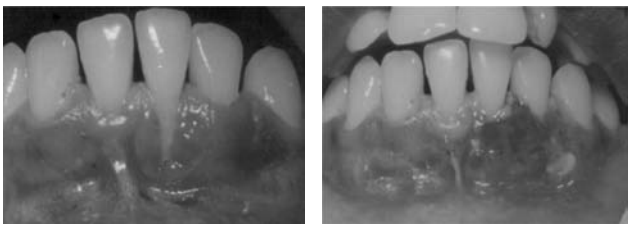
One of the first studies supporting this concept done by Lang & Loe (1972)[1] on dental students suggested that 2mm attached gingiva is adequate to maintain periodontal health. Miyasato[2] & Grevers (1977)[3] later conflicted the results of Lang & Loe study and opined that clinically healthy gingival tissues exist even in sites with less than 1mm of attached gingiva. Later in 1983 Wennstrom & Lindhe[4] in an animal study showed that gingival width can be maintained free of clinical and histologic signs of inflammation irrespective of the presence or absence of attached gingiva by strict plaque control measures.

Gingival augmentation and periodontal health

The concept of gingival augmentation to improve periodontal health is poorly supported by scientific evidence. Dorfman (1980)[7] conducted a study where sites with minimum attached gingiva were grafted and similar defects were kept non grafted. On 6-8 yrs followup, grafted sites showed increase in gingival width considerably, but non grafted sites with less than 2mm attached gingiva showed no further clinical attachment loss and recession when strict plaque control measures were ensured. This result was further supported by Hangorsky & Bissada (1980), Schoo & VanderVeden (1985), Wennstrom (1985) and Friedman (1999).

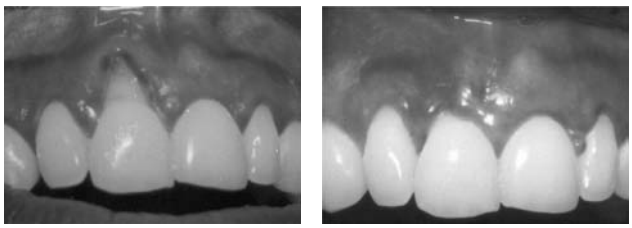
Attached gingiva and orthodontic treatment

Alteration in gingival dimensions during orthodontic treatment is dependent on the direction of tooth movement. As far as a tooth moves within the alveolus, recession will not develop (Wennstrom 1987)[8]. In areas of narrow zone of attached gingiva, Batenhorst et al (1974)[9] observed dehiscences in bone plates when teeth are moved labially or lingually and labial movement



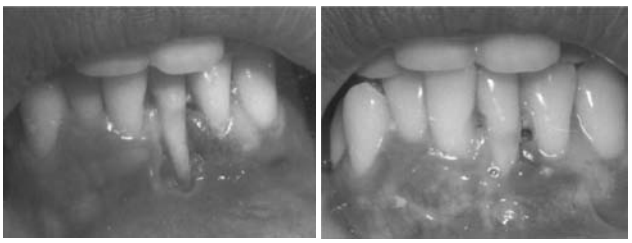
Laterally displaced flap

Pre op Post op



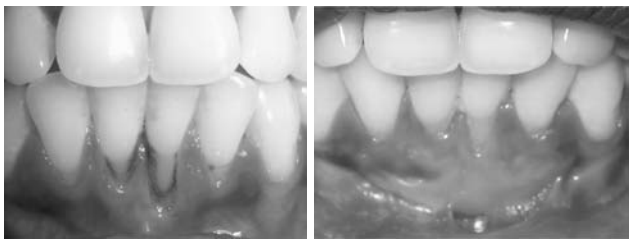
Laterally displaced flap

Preop Post op



Free subepitheial connective tissue graft

Pre op Post op



Free epithelialized palatal graft

Pre op Post op

increased gingival recession. Maynard & Wilson suggested the need for gingival augmentation before orthodontic treatment in such situations. Boyd (1978)[10] opined that if there is gingival recession labially and if the tooth is to be moved lingually, orthodontic treatment is to be done first.

Steiner et al (1981)[12] speculated that it is the thickness of marginal tissue rather than the apicocoronal height that will decide whether marginal tissue recession develops during orthodontic treatment. Recently Melson & Allais (2005)[13] and Yared (2006)[14] observed from their studies that it is the thickness of gingiva that is more critical in preventing soft tissue recession. Presence of inflammation will increase the predilection for soft tissue recession in "thin gingival biotype" subjects.

Attached gingiva and restorative therapy

Subgingival placement of restoration margins are critical. Donaldson (1974)[14] stressed proper contour of restoration subgingivally to prevent recession. Maynard (1987)[15] stressed the need for 3mm AG in cases where crowns are to be placed subgingivally. Stetler & Bissada (1987)[16] recommended a minimum width of 2mm of AG in areas with subgingival margins of restorations. Also the keratinized tissue should be thick enough to prevent recession in areas where subgingival restorations are to be placed, ie a probe in the gingival crevice should not be seen through.

Consensus & conclusions

1. Some amount of attached gingiva is a clinical prerequisite to prevent periodontal breakdown.

2. Width of attached gingiva is related to the depth of the vestibule

3. Excellent plaque control can prevent gingival inflammation even in areas devoid of attached gingiva.

4. But plaque control is difficult in areas without attached gingiva.

5. Height of gingiva is not a critical factor to predispose the site to gingival recession but thickness of gingiva is a significant predisposing factor.

6. To preserve gingival dimensions after orthodontic treatment, a careful pre treatment evaluation of the thickness of the soft tissues is important.

7. Thickness is critical than the apicocoronal width of gingival to maintain periodontal health after subgingival restorations.

8. Minimum attached gingiva with good vestibular depth dose not demand augmentation.

9. The same minimum width of attached gingiva with poor vestibular depth will be benefited by augmentation.

Thus it can be stated that, **any minimum width of attached gingiva is acceptable if there is no clinical signs of inflammation, no difficulty in oral hygiene maintenance and no aesthetic problem to the patient.**

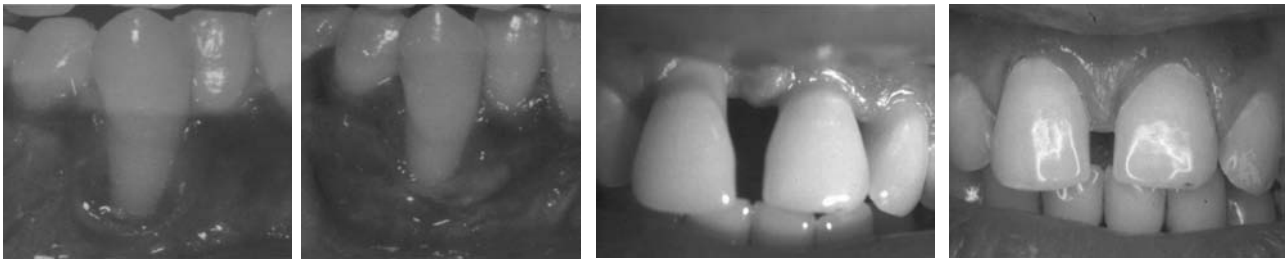
Techniques for gingival augmentation

1 Vestibular Extension operations

Denudation techniques (Karring et al)

Periosteal retention (spit flap)

Apically repositioned flap (Friedman)



Guided Tissue Regeneration with FEPG (Elligard)
Pre op Post op

Gingival prosthesis (gum veneer)
Pre op Post op

2 Pedicle grafts

Rotational flap procedures

- lateral sliding flap (Grupe & Warren)
- double papilla flap (Cohen & Ross)
- oblique rotated flap (Pennel et al)

Advanced flap procedures

- coronally repositioned flap (Bermoulin et al)

(Allen & Miller)

- semilunar coronally repositioned flap (Tarnow)

3 Free grafts

Epitheialized graft (Sullivan & Atkins, Miller)

Subepithelial connective tissue graft (Langer & Langer)

(Raetzke & Allen)

4 Guided Tissue Regeneration (Tinti & Vincenzi, Cortellini, Pini Prato)

5 Combination procedures

Clinical case series

(Figures and figure legends enclosed after the reference session)

Conclusion

Periodontal plastic surgical procedures have a prominent role in current dental practice. When used judiciously weighing the merits and demerits of each procedure with the clinical situation, predictable positive treatment results are possible. Gingival autotranspants also facilitate successful practice of interdisciplinary dentistry. This is an area where Periodontist can join hands with other specialists in the field to deliver comprehensive dental care for the community at large

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Case report

Report of a case of radicular dense invaginatus(dilated composite odontome) with differential diagnosis

*** Sheeba Padiyath, **Anita Balan**

Abstract

Dens invaginatus (dens in dente, "tooth within a tooth", dilated composite odontome) is a developmental dental abnormality presenting as a deep, enamel lined invagination in the crown ("coronal dens invaginatus") or root (radicular dens invaginatus). The true radicular dense invaginatus is rare and present radio-graphically as an enlargement of root. Here we are presenting a rare case of radicular dense invaginatus and are trying to emphasize the importance of the differential diagnosis of localized peri-apical radioopacity.

Introduction

Odontomas are composed of dentine and enamel in amorphous conglomerations (complex odontomas) or in rudimentary tooth like structures (compound odontomas).[1] Odontogenic epithelium and mesenchyme may also be found depending on the stage of development. Odontomas are discovered incidentally in children or young adults during routine radiographic examination or during investigation of a missing or displaced tooth. Complex odontomas are more common in the posterior mandible and present as a well defined and uniform radio-opacity surrounded by a radiolucent rim that represents a fibrous capsule. Variations in the degree of radio-opacity due to the presence of various dental tissues may facilitate differential diagnosis from other radio-opacity.[2] The presence of multiple teeth like structures of various size and shape is diagnostic of compound odontoma. These are more common in the anterior maxilla. Simple excision is curative. There is at least one report of a compound odontoma in the periapical and interradicular area of a second primary mandibular molar with associated root resorption. Superimposition of an odontoma over the root of an impacted tooth was a definite consideration in this case.

Case report

A 23-year old male reported with recurrent painful swelling of the left upper jaw since one year. He had been having recurrent swelling of the left upper jaw about 3-4 times for the last one year. He felt pain in relation to erupting 28 and swelling appeared with trismus and pus discharge. He consulted local doctor took medicines and swelling subsided. His dentist diagnosed a caries exposed 27 and attempted extraction, but was not able to extract the tooth. A part of the tooth was fractured and a mass appeared to come out. So he referred him to our department. His 27 was decayed and according to him 28 was in half way erupting condition. No other relevant dental, medical or family history was noted. Extra orally he had a diffuse swelling involving the left maxillary area lower to the median aspect of the left eye upto anterior aspect of left ear. Superior inferiorly it extended from lateral aspect of eye to the left lower border of mandible without any expansion. Skin over the swelling was normal and was firm in consistency. On palpation size and extension of the swelling was confirmed. Intra-orally patient had all teeth except 37 and 47 and 27 was fractured. A hard tooth like mass projected from the posterior aspect of 27. This hard swelling was about 2x2 cm in size. An upper occlusal view and a panoramic view were taken. There was a large homogenous mixed, radioluecent and radio opaque mass of 3x4cm was seen posterior to 26 and a part of crown of 27 was fractured and the swelling was in continuous with the rest of the tooth. Posteriorly, it extended into the maxillary sinus according to occlusal view. Panoramic view showed maxilla and mandible with full complement of teeth in upper jaw except 18, 37 and 47. 38 and 48 were mesially tilted. 28 was impacted and malformed with dilacerations of roots in association to which was a large mixed radio-opaque, radio-lucent mass almost filling left maxillary tuberocity. This was predominantly radio-opaque, oval in shape, 3x4 cm^2 extending from the distal portion of root of 27. The mass is lined by a radio-lucent border which is scalloped on superior aspect to enclose the superior aspect of the mass, the dilacerated root of 28 and its crown.

Differential diagnosis

The differential diagnosis of a localized, peripheral radiopacity includes true periapical lesions,such as cementoblastoma, hypercementosis, periapical/focal cemento osseous dysplasia,and focal sclerosing osteomyelitis,as well as lesions that may coincidentally be found near a tooth apex, such as odontoma, cemento ossifying fibroma, osteoma and osteoblastoma/osteoid

osteoma. Underlying the need for the formulation of a thorough differential diagnosis is the observation that the biological behavior of these lesions varies from totally innocuous to aggressive, and the recommended treatment from simple radiographs follow up to surgical excision.

A cementoblastoma (true cementoma) is a rare tumor of neoplastic cementoblasts. Radiographic examination usually shows a well defined, circumscribed radio-opacity confluent with the root or roots of teeth, surrounded by a thin radiolucent halo. Root resorption, loss of root outline, and obliteration of the periodontal ligament space may also be seen. Based on a review by Brannon et al. of 44 of their own cases and an additional 74 cases identified in the literature, the mean age at presentation was 21.3 years, with a slight male predilection. Both jaws wee affected, although 79.5% of the cases were located in the mandible, most commonly associated with the first mandibular permanent molar. Most cases presented with cortical expansion and pain. Cementoblastoma is considered to represent a benign neoplasm with locally aggressive biologic behavior and a high recurrence rate.

Hypercementosis representing excessive deposition of cementum around the apex of a tooth may present as a well defined radioopaque mass fused with the root of a vital tooth resulting in a club shaped appearance. This excess cementum may be surrounded by a thin radiolucent halo of uniform width, representing the normal periodontal ligament space. This condition has been associated with various local stimuli – trauma, altered function, inflammation – and systemic factors – Pagets disease, hyperthyroidism – but in most cases represents an idiopathic age related phenomenon. It is most common in the premolar area and as it is asymptomatic is usually found in routine radiographic examination. The lack of opposing tooth is predisposing factor for hypercementosis.

A low grade inflammatory stimulus, such as chronic peri-apical inflammation or malocclusion may be the causative factor of focal sclerosing osteomyleitis – condensing osteitis, periapical osteosclerosis – When no apparent cause can be identified, the term idiopathic osteosclerosis is applied. Condensing osteitis and idiopathic osteosclerosis are the most common periapical radioopacities found in adults and are typically discovered during routine radiographic examination. They commonly present as a uniform periapical radioopacity around a mandibular molar tooth.

Cemento-osseous dysplasias are relatively common fibro osseous lesions of the tooth bearing areas of the jaws. They are generally asymptomatic and usually discovered on routine radio graphic examination. Most of the cases are found in close proximity to the apices of the vital teeth, commonly the mandibular anterior teeth of middle aged women. They start as periapical radiolucencies that may mature overtime into circumscribed radioopacities surrounded by a radiolucent rim.

Odontome is a most common benign odontogenic tumor, containing all the various component tissues of teeth. They seemed to result from budding of extra odontogenic epithelial cells from the dental lamina. This cluster of cells forms a large mass of tooth tissue that may be deposited in an abnormal arrangement and consists of normal dentine, enamel, cementum and pulp. When tooth components are well recognized and tooth like structures are formed the lesion is termed a complex odontome. The most common site for complex odontome is the posterior aspect of jaws. The radiographic appearance is that of a opacity situated in the bone, having a density greater than that of a tooth. One highly important feature is the presence of a fibrous capsule around the mass which appears as a thin dark line surrounding the dense opaque mass.

Ossifying fibroma is a rare benign bone neoplasm that is more frequently found in the posterior mandible. The radiographic appearance of this lesion varies from a unilocular radiolucency to a rarely radioopaque mass surrounded by a well defined radiolucent rim.

Osteoma is a benign tumor of the jaws, most commonly encountered in young patients, that usually involves the body of mandible or the condyle. Multiple osteomas may be a component of Gardner syndrome.

Management and diagnosis

Under local anaesthesia, a mucoperiosteal flap was raised posterior to the maxillary left first molar. The cortical bone was removed, exposing the odontome. A globular mass protruding from the tooth root was seen. It was easily shelled out and the surgical flap was repositioned and sutured. Healing was uneventful.

Macroscopically a hard globular mass was seen at the apex of the tooth. The globular mass consisted of an extension of the radicular dentine that encircled the mass of a hard tissue (Fig). Microscopic examination showed that the dentine surrounding the mass was primarily mature dentine with well oriented tubules continuous with the radicular dentine. Also noted were enlarged tubules and circular and oval cavities that contained connective tissue. The dentine was lined by enamel and inner mass consisted of enamel matrix, foci of osteoid/cementoid material, and connective tissue. A communication of the dilation with the outer root surface could not be located with certainty, but a small brown line suggestive of such a communication was present at the apical end of the globular mass. The diagnosis was consistent with radicular dens invaginatus.

Review and discussion

Dens invaginatus(dens in dente, tooth within a tooth, dilated composite odontome) is a developmental dental abnormality presenting as a deep enamel lined invagination in the crown(coronal dens invaginatus) or root (radicular dens invaginatus).[1] The true radicular dens invaginatus is rare and presents radiographically as an

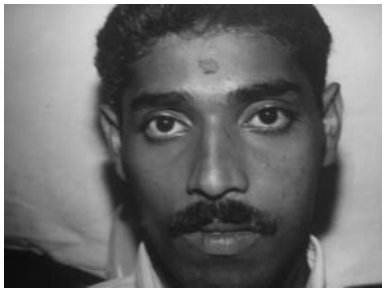

Fig 1. Extra Oral view

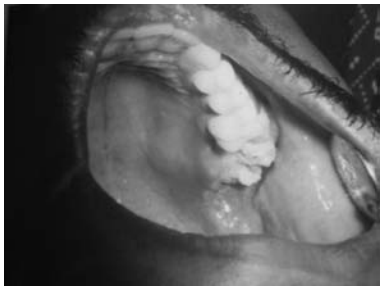

Fig 2. Intra Oral view of the odontome

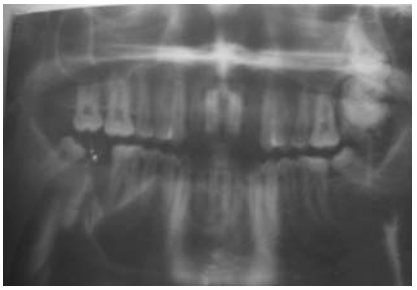

Fig. 3 Panoramic view

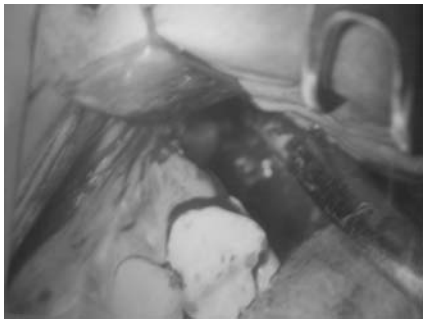

Fig 4. Intra Oral view during excision

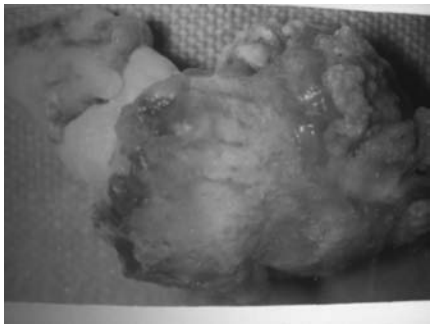

Fig 5. Surgically excised lesion

enlargement of the root.[2-4] A review of the English literature disclosed 7 case reports.[1-4] The typical radicular dens invaginatus is an enamel lined invagination containing bone which communicates with the root surface with a small opening.[1,2,4] But communication was not identified in 4 of the cases reported.[2,3,5]

The clinical features of previously reported cases of radicular dens invaginatus and the present case are matching. The most commonly affected were incisors and third molars.No cases were reported in association with an impacted tooth.Three patients exihibited pain from abscess formation or pericoronitis.[3,4,12]

Radicular dens invaginatus has been attributed to the proliferation and ingrowth of Hertwigs epithelial root sheath (HERS) into the dental papilla, followed by dental follicle connective tissue.[2,3,4,12] Subsequently HERS cells differentiate into ameloblasts, while dental follicle mesenchymal tissue forms cementum and bone. During normal odontogenesis, most HERS cells are lost through apoptosis after deposition of the first layer of radicular dentine.[13] Then HERS develops fenestrations and dissolves, leaving small groups of cells in the periodontal ligament, known as rests of Malassez.

Rushton[2] suggested that dens invaginatus and complex composite odontome share a common pathogenetic process, and used the term dilated composite odontoma for the former. Rushton proposed that what differentiates them is that in dens invaginatus the disturbance occurs later in odontogenesis, thus the tooth germ follows a largely normal differentiation pattern, there by forming a recognizable tooth. According to this view radicular dens invaginatus can be considered a mature odontoma, the distinction from conventional odontoma.

The differential diagnosis in the present case also included a complex odontoma fused with the tooth root. It was in accordance with Piatteli etal.[11] The lesion was attached to the interradicular region of a retained second primary molar and was composed mainly of cementum like tissue with areas of enamel and dentinal tissue. In our case the globular mass consisted of a dilation of the radicular dentine that was lined by enamel and contained mostly enamel matrix, cementoid/osteoid material but not dentine.Thus we suggest that our case is consistent with a radicular dens invaginatus, and is quite similar to cases reported by Rushton.[2]

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Management of intrabony defect with Osseograft and with membrane

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Abstract

Deep intraosseous defects represent a major challenge for the clinician. Sites with intraosseous lesions are at higher risk of disease progression. Bony lesions may not be readily accessible to periodontal debridement, requiring access flap surgery alone or in association with bone-resective or regenerative procedures. The use of bone substitutes in combination with the barrier effect has been reported to enhance the regenerative clinical outcome, by providing a better support to the membrane or by adding the potential osteoinductive properties of the grafting material to the barrier effect. This article reports two cases-one where demineralised bone matrix alone and the other where DBM and GTR membrane was used to achieve regeneration

Introduction

Grafting of biomaterials and application of biological agents have been used with varying success in the past decades to accomplish the reconstruction of lost attachment apparatus in deep intraosseous defects. A number of materials and procedures have been used to achieve periodontal regeneration including various types of bone substitutes for grafting and barrier materials for Guided Tissue Regeneration. Data from various controlled clinical trials have demonstrated that some of the available grafting procedures may result in healing that can be termed 'periodontal regeneration' i.e. formation of new cementum, bone and periodontal ligament.

Demineralized bone matrix (DBM) allografts, and guided tissue regeneration (GTR) used alone or in combination are some of the therapeutic approaches applied for these purposes.[1,2] GTR is currently used for the treatment of periodontal intrabony defects,[3] class II furcations defects,[4] gingival recession defects,[5] as well as augmentation of atrophic alveolar ridges and alveolar bone defects associated with dental implants.[6] The application of GTR implies that the lesion becomes colonized by cells with the ability to regenerate the particular type of tissue that has been lost.

Demineralized bone matrix (DMBM; Osseograft, Chennai, India) is a bone inductive sterile bioresorbable xenograft prepared from bovine cortical bone samples, resulting in nonimmunogenic flowable particles of approximately 250 μm that are completely replaced by host bone in 4–24 weeks. Studies have indicated that low-molecular-weight, acid-insoluble proteins contained in small quantities in the matrix may act as modulators of the bone induction process. These proteins are known as *bone morphogenetic proteins (BMPs)*.[7,8] Healiguide is a resorbable collagen membrane (Chennai, India).

Discussed below are two cases of intraosseous defects treated with DBM and another with GTR both showing good results.

Case report-1

A 27 year old male reported with complaint of generalized bleeding gums. Patient gave no relevant medical history. His mother was reported to have lost her teeth at an early age. On examination there was deep pockets (7-8mm) associated with intra-bony pockets with respect to lower first molars Based on history, clinical and radiographic findings, a diagnosis of localized aggressive periodontitis was made. The intrabony defect associated with 46, with probing pocket depth of 8mm, (Fig-1,2) was treated by flap surgery with bone graft (Osseo graft).

Presurgical Protocol

The initial preparation phase for treatment consisted of oral hygiene instructions, scaling and root planing. Occlusal therapy and re-evaluation was done 4 weeks after the completion of this first phase of therapy. The probing measurements were done with a customized acrylic stent that was used as a fixed reference point to

Case-1

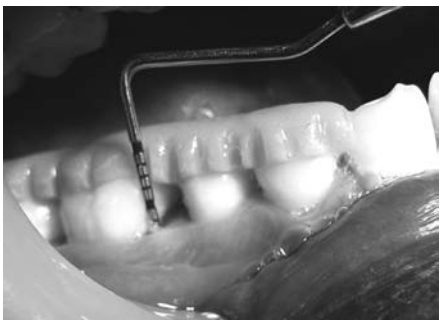

Fig 1. Preop probing depth of 8mm on mesial line angle of 46

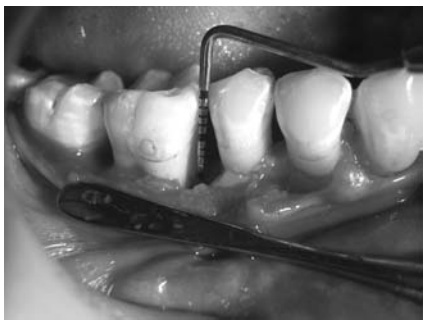

Fig 2. After debridement, intra-bony defect of 5mm is seen

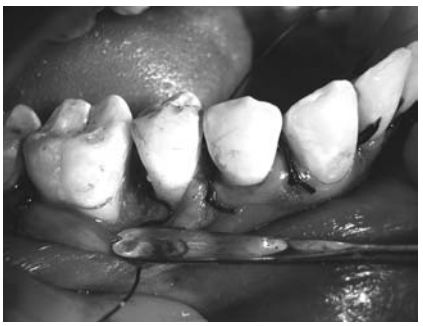

Fig 3. Bone defect is filled with Osseograft

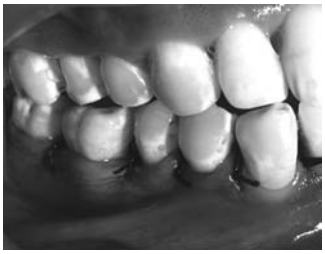

Fig 4. Interrupted sutures in place

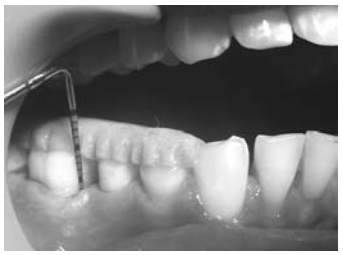

Fig 5. 6-months Post-op. Probing depth-4 mm

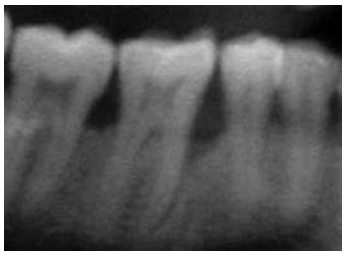

Fig 6a. Preop IOPA radiograph

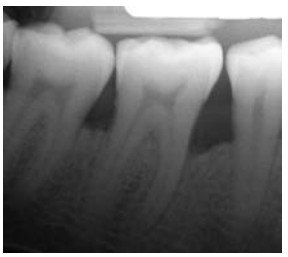

Fig 6b. 6-months post-op IOPA showing bone fill

minimize distortion. The stent was grooved in the occlusal apical direction with a tapered bur so that the UNC-15 probe was placed at the same position for each successive measurement. One site representing the same deepest point of the defect was included: the fixed reference point (FRP) to the base of the pocket (BP) and the fixed reference point to the cementoenamel junction (CEJ). All the measurements were made by 1 examiner, using a periodontal probe, before and after surgery for test and control sites at baseline, 3 months and 6 months.

Pocket depth and clinical attachment level were calculated from the clinical measurements:

Pocket depth = (FRP to BP) – (FRP to gingival margin [GM])

Clinical attachment level = (FRP to BP) – (FRP to CEJ)

Surgical Protocol

The surgical procedure was done under local anesthesia (2% lidocaine with epinephrine 1:100,000). Intrasulcular incisions were made and full thickness flaps were raised. Debridement and root planing were done. Osseograft was mixed with 4 to 6 drops of saline in a sterile dappen dish and to form a paste-like consistency. Graft material was condensed in the 3-walled defect until the intrabony was completely filled (Fig. 3). The soft-tissue flap was repositioned at the original level and closed with interrupted direct-loop sutures of silk to achieve a tension-free primary closure (Fig. 4). The surgical site was protected with a periodontal dressing. Post-operative antibiotics and analgesics were administered along with 0.12% Chlorhexidine rinse twice daily for 14 days to help control plaque. Also patient was advised to avoid chewing in area of the surgery for 2-week period and told not to brush at the surgical site or manipulate it for 10 days. After 10 days, the dressing and sutures were removed. Recall appointments were scheduled at 3 and 6 months after the surgery for soft-tissue evaluation and plaque control. Radiographic evaluation and clinical variables were recorded at 6 months. (Fig-5, 6)

Result

Clinical healing was uneventful with no signs of adverse tissue reactions indicating that the implant material fulfilled the demands of biocompatibility. Patient showed excellent maintenance at the post-operative evaluation. The treated site showed probing depth reduction of 3mm and CAL gain of 3mm at 6-month post-evaluation. Radiograph showed considerable bone fill at the end of 6 months (Fig. 6).

Case -2

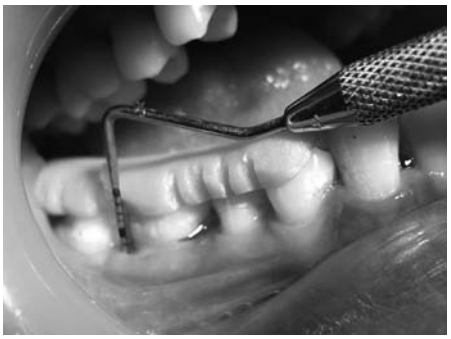

Fig 7. Preop probing depth of 7mm on distal line angle of 46

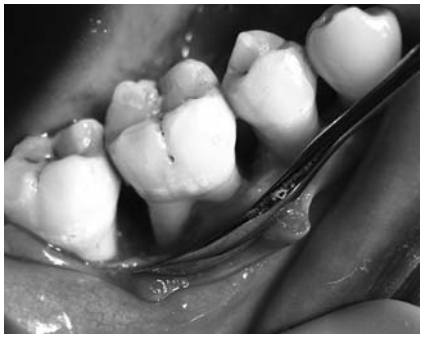

Fig 8. After debridement, intra-bony defect on distal of 46 is seen

Fig 9. Healiguide membrane is cut to the defect size

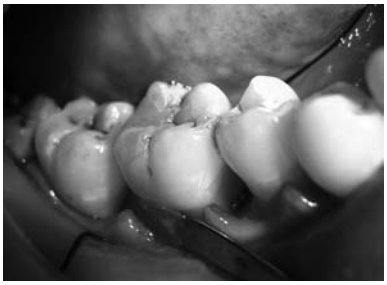

Fig 10. Healiguide membrane is adapted to the defect.

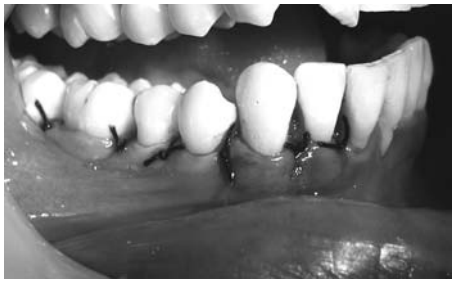

Fig 11. Interrupted sutures in place

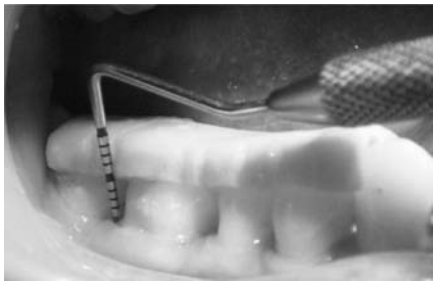

Fig 12. 6-months Post-op. Probing depth-5 mm

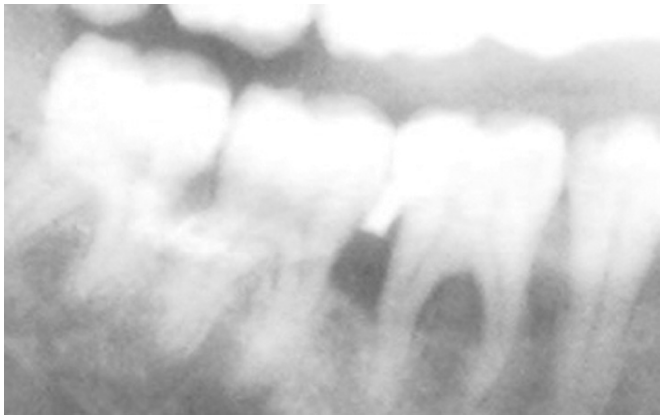

Fig 13a. Pre-op radiograph

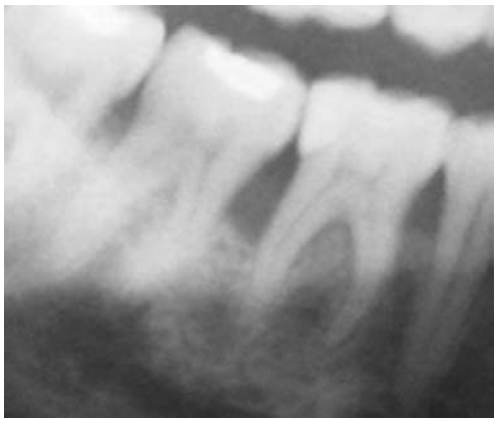

Fig 13b. 6-month post-op radiograph

Case report-2

A 32-year old female patient reported with chief complaint of bleeding from the gums noticed since about 5-6 months. There was no relevant medical history or history of any dental treatment in the past. Examination, revealed generalized deep pockets 6-8 mm deep, deep intraosseous defect of 7mm with respect to distal of 46. (Figure -7) Based on the history, clinical and radiographic findings, a diagnosis of chronic generalized periodontitis was made.

Surgical Protocol

The same presurgical and surgical protocol was followed as above. After achieving anesthesia, full thickness flap was raised. Debridement and root planing were done dressing with hand instruments (Gracey Curettes). Osseograft mixed with saline was condensed in the 2-walled intra-bony defect on distal aspect of 46 (fig-8) until the defect was completely filled. Healiguide barrier membrane was then adapted over the grafted site. The soft-tissue flap was repositioned at the original

level and closed with interrupted direct-loop sutures of silk to achieve a tension-free primary closure. The surgical site was protected with a periodontal dressing. Post–surgical instructions were given; antibiotics and analgesics were administered along with 0.2% Chlorhexidine rinse twice daily for 14 days to help control plaque. After 10 days, the dressing, sutures were removed. Recall appointments were scheduled at 3 and 6 months after the surgery for soft-tissue evaluation and plaque control. Radiographic evaluation and clinical variables were recorded at 6 months.

Result

No signs of adverse tissue reaction were observed and healing was uneventful indicating that the combination of both implant materials fulfilled the demands of biocompatibility. Patient showed excellent maintenance at the post-operative evaluation. A probing depth reduction of 3mm and CAL gain of 3 mm was observed (Fig. 12). Radiograph showed bone fill at the end of 6 months (Fig. 13).

Discussion

Autogenous bone grafts are the undisputed 'gold standard' in bone grafting, considered far superior to any type of bone grafts; However with the more widespread application of bone grafting as in replacement of large bony defects caused due to trauma or wide resection of tumors, large amounts of bone are required. Procuring autografts requires an additional surgical procedure on the same patient increasing the risk of infection, increasing blood loss, lengthening the operating time and leading to possible increased morbidity. Consequently extensive research and various methods of preparing preserved allografts and xenografts have been explored.[9]

Osseograft consists of demineralised bone matrix that is prepared from bovine cortical bone samples. Bovine derived xenograft has been reported to possess good osteoconductive properties and is well integrated into bone tissue.[10] The material is very well tolerated and, until now, no allergic reactions related to the material have been reported.[11] The clinical results following treatment of intra-bony defects with Bovine Derived Xenograft were comparable with those obtained with demineralized freeze dried bone allograft (DFDBA).[12] The risk of bovine spongiform encephalopathy spreading through the graft is several orders of magnitude less than the risk of death due to lightning, tornadoes and other remote events, given the strict protocols followed in sourcing and processing of raw bovine bone for human use.[13]

Filling the defect with the bone material facilitated placement of the barrier and also prevented collapse of the barrier into the defect in Case-2. The uneventful clinical healing with no signs of adverse tissue reactions indicates that the combination of the two implant materials fulfills the demands of biocompatibility.

Sampath and Reddi[14] reported that subcutaneous implantation of coarse powders (74–420 μm) of DMBM results in local differentiation of bone. Once the Osseograft is placed in the osseous defect, a sequential differentiation of mesenchymal-type cell occurs to form cartilage and bone. There are 4 stages of cell differentiation and bone formation. Stage 1 includes mesenchymal-cell migration into the vascular spaces of matrix within 2 days. In stage 2, mesenchymal cells differentiate into giant cells and chondrocytes between day 2 and 18. In stage 3, the poorly vascularized areas of matrix show cartilage formation at day 8 and 20, and from day 10 to 20 woven bone develops in the vascularized areas of matrix. During stage 4, bone formation occurs between day 20 and 30.[15]

Guided tissue regeneration (GTR), techniques has been proven histologically in animals and humans[16,17] that substantial gain of new attachment, i.e., newly formed periodontal ligament fibers inserting in new cementum will be obtained on roots deprived of periodontal ligament and cementum. Considerable CAL gain has been demonstrated in case reports following bioresorbable barrier treatment of two- and three-wall intrabony defects.[18,19]

The properties of the collagen barrier as reported by Chen et al.(1995)[20] are the following: (1) It is either incorporated into the healing connective tissues or degraded by macrophages in 6–8 weeks. (2) It is chemotactic to fibroblasts from periodontal ligament and gingivae. (3) It creates a thrombogenic surface that stimulates platelet attachment, producing hemostasis. In addition, collagen materials possess additional advantages including weak immunogenicity, ease of manipulation and the ability to augment tissue thickness by providing a collagenous scaffold.

Using graft material in conjunction with GTR may prevent membrane collapse and promote bone formation. The combined treatment with GTR and implantation of DBM was shown to be effective in producing bone regeneration in calvarial defects,[21] and in alveolar bone defects associated with dental implants in dogs and humans.[22] However, other investigators using GTR and DBM implantation for bone regeneration in various types of peri-implant defects in dogs and in extraction sites in humans failed to demonstrate any added effect of the DBM implantation.[23,24]

The fact that 3mm CAL gain could be achieved in both Case-1 treated by Osseograft and Case-2 treated by Osseograft and Healiguide, could be due to the difference in the intra-osseous defect morphology. Case-1 presented with a three-walled defect ideal for regeneration, whereas in case of Case-2 the defect was 2-walled and still 3mm of CAL gain could be achieved.

Conclusion

DMBM (Osseograft) alone and in combination with Guided tissue barrier membrane (Healiguide) improved healing outcomes i.e., reduction of probing depth, resolution of osseous defects and gain in clinical attachment. Better biocompatibility, excellent handling properties and the improved response of tissues to the material are definite benefits of using DMBM (Osseograft). Controlled clinical trials with more patients and standardized radiographic techniques are necessary to analyze the maximum potential of xenografts for regenerative periodontal therapy and to compare the results obtained by using only graft and / or graft and membrane together.

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Review

The smile architecture

* Sangeeth Sasidharan, ** Rajesh Pillai, ***Ganesh C.

Abstract

In an effort to create natural esthetics, the clinician must give careful consideration to the patient in his or her entirety. Individual attributes of a tooth may represent only part of the story, because teeth do not exist individually and separate from the patient to whom they belong. Combinations of tooth forms when positioned together can create an effect that is greater than, equal to or less than the sum of the parts. The popularity and increasing predictability of recently developed restorative techniques such as porcelain veneers have created new demands on practitioners. While any type of tooth restoration can be done as a single unit or in multiples, the cumulative visual impact of the anterior dentition often transcends the sum of the individual parts. This article reviews some of the principles that are followed on smile design.

Smile design theory can be broken down into at least four parts: facial esthetics, gingival esthetics, microesthetics and macroesthetics.[1] Facial and muscular considerations vary from patient to patient and are worthy criteria for evaluation. Photographic analysis can determine how the lips and soft tissue frame the smile in different positions of speech, smiling and laughter. Esthetic conditions related to gingival health and appearance are an essential component of effective smile design. Inflamed, uneven gingival lines detract from a pleasing smile. Blunted papilla and asymmetric gingival crests become part of the overall esthetic picture. Microesthetics involves the elements that make teeth actually look like teeth. The anatomy of natural anterior teeth is specific for each tooth and that tooth's location in the dental arch. Specific incisal translucency patterns, characterization, lobe development.

Principles

The principles of smile design are divided into four parts:

Facial Esthetics. Facial and muscular considerations vary from patient to patient and are studied through visual and photographic analysis. They include how the lips frame your smile when you speak, smile or laugh.[2]

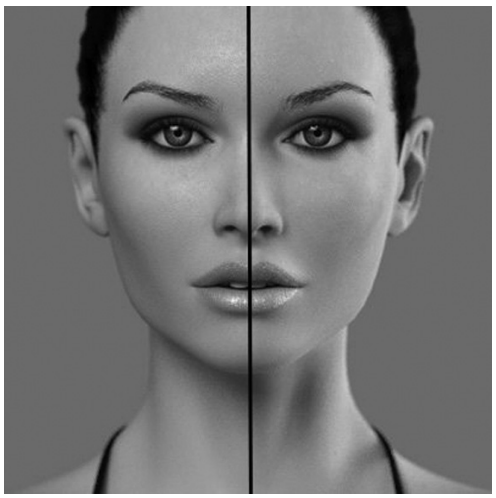
Gingival Esthetics. The health and appearance of your gums are essential elements in smile design. Excessive gingival display, uneven gum contours, inflammation and exposed root surfaces are common gingival-based esthetic complaints that detract from your smile's appeal.

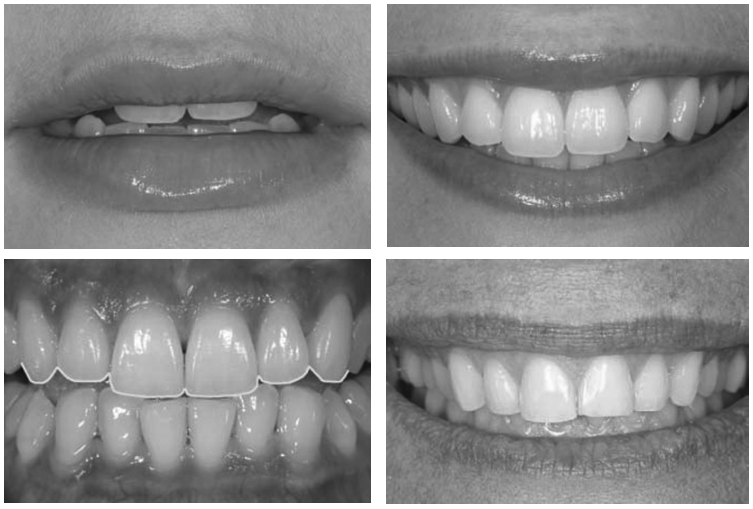
Microesthetics. This involves the subtle characteristics that make your teeth look the way they do, such as how they reflect light and unique marks or colorations. The ideal restoration is one with qualities closely resembling those of natural teeth. The anatomy of natural teeth is unique from person-to-person and specific to each tooth.

Macroesthetics. This analyzes the relationships and proportions between front teeth, surrounding tissue landmarks and facial characteristics, in order to ensure natural and attractive restorative care and smile makeover treatment. Working in collaboration, your cosmetic dentist and dental laboratory technician combine their technical and artistic abilities to create a natural and esthetically pleasing appearance in which the shapes, sizes and arrangement of individual teeth blend with and complement your particular features.[1]

In an effort to create natural esthetics, the clinician must give careful consideration to the patient in his or her entirety. Individual attributes of a tooth may represent only part of the story, because teeth do not exist individually and separate from the patient to whom they belong. Combinations of tooth forms when positioned together can create an effect that is greater than, equal to or less than the sum of the parts. The popularity and increasing predictability of recently developed restorative techniques such as porcelain veneers have created new demands on practitioners. While any type of tooth restoration can be done as a single unit or in multiples, the cumulative visual impact of the anterior dentition often transcends the sum of the individual parts. This article reviews some of the principles that are followed on smile design

Smile design theory can be broken down into at least four parts: facial esthetics, gingival esthetics, microesthetics and macroesthetics.[1] Facial and muscular considerations vary from patient to patient and are worthy criteria for evaluation. Photographic analysis can





determine how the lips and soft tissue frame the smile in different positions of speech, smiling and laughter. Esthetic conditions related to gingival health and appearance are an essential component of effective smile design. Inflamed, uneven gingival lines detract from a pleasing smile. Blunted papilla and asymmetric gingival crests become part of the overall esthetic picture. Microesthetics involves the elements that make teeth actually look like teeth. The anatomy of natural anterior teeth is specific for each tooth and that tooth's location in the dental arch. Specific incisal translucency patterns, characterization, lobe development.

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Smile design should involve the evaluation of certain elements in a specific sequence;[4]

(1) facial analysis

(2) dento-facial analysis

(3) dento-labial analysis

(4) dento-gingival analysis

(5) dental analysis

The dentofacial analysis include the relationship between the dental and facial midlines and The maxillomandibular relationships with the face

The dentolabial analysis deals with the relationship of the teeth to the lips such as incisal edge position, incisal display during smiling, Smile line, buccal corridor,

The dentogingival analysis involves the relationship of the teeth to the gingival, which includes the gingival line.

The dental analysis includes the intertooth and intratooth relationships, ie, form and position along with color.

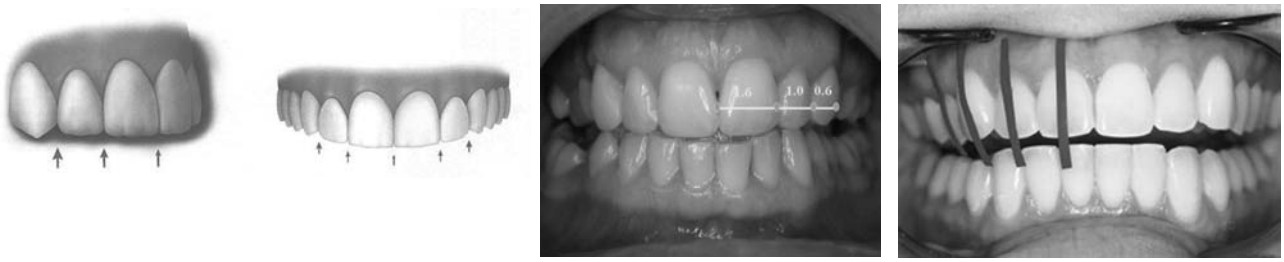
Components of a Smile

Smile esthetics involve applying certain rules, tools and strategies to the assessment of teeth and gum conditions in order for your dentist to decide on cosmetic and restorative procedures to correct and/or enhance your appearance.

They include

Lips

For optimal esthetics, the facial features should line up to the teeth and lip lines. When the lips form a broad smile, an imaginary line can be drawn through the



corners of the mouth, from one side to the other. The amount of upper front (maxillary anterior) teeth revealed below this line helps create a vibrant, youthful image. In a youthful smile, the upper front teeth should fill between 75 to 100 percent of the space between your upper and lower lips in a full smile.

Midline

The starting point of any smile design is the facial midline, an imaginary vertical line drawn between the front two upper teeth. For optimal esthetic value, the facial midline should be in the middle of the face.

Prominent facial features – such as the eyes, nose and chin – can be misleading when locating the midline. For instance, your eyes may be at slightly different levels, or your nose may be off-center, lessening their usefulness when trying to find the midline. A more accurate approach to determining the facial midline focuses on two facial landmarks: a point between the eyebrows and the Cupid's bow in the center of the upper lip. By drawing a line between these landmarks, dentists can locate the position of the facial midline while also determining the midline's direction.

Whenever possible, the midline between the upper front teeth (central incisors) should coincide with the facial midline. In cases where this is not possible, the midline between the central incisors should be perpendicular to the imaginary line that could be drawn through the corners of the mouth.

Smile Line

The smile line is the line created by the top of lower lip. In an ideal smile line, the edges of the upper teeth should be parallel to the lower lip when you smile. The bottom of the lower lip should have the same line as the gums of the lower jaw. This should always be a standard, regardless of the size or shape of the smile. Once the orientation of your smile line has been determined, its curve, or shape can be designed and the length of the new restorations can be determined.

Teeth

Attractive smiles have various things in common, such as teeth that are white, unstained, straight, evenly spaced with no gaps between them and not crowded or overlapping. When you smile, your top teeth show fully in a good proportion to your gums. The line where the gums and teeth meet is smooth and even. The smile line of the upper teeth follows the curve of the lower lip. The midline of the upper front teeth ideally is in the center of the face. "Tooth reveal" is a term that describes the amount of tooth structure that shows during different views and lip positions.

Other significant considerations for teeth that influence a person's smile include:

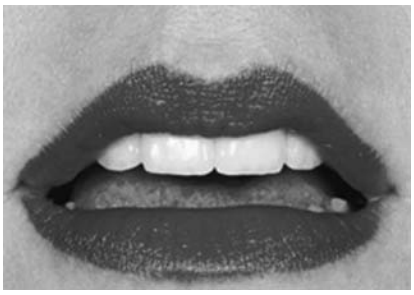
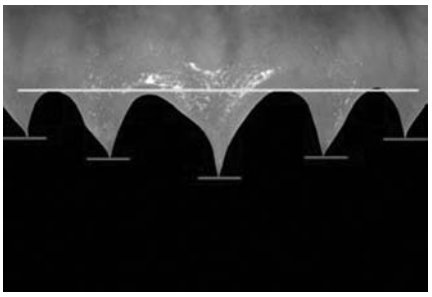
Incisal Embrasures. The spaces between the edges of the teeth (embrasure spaces) follow a pattern that develops between the central incisors and then progress sideways. These silhouette patterns, created by the edges and separations between the upper front teeth against the darker background of the mouth, help accentuate an attractive smile. The size and volume of the incisal embrasures between teeth increase as the teeth move away from the midline.

Color. Typically, the upper central incisors are the lightest and brightest teeth in your smile. The upper side teeth are similar in color (hue) to that of the central incisors, but generally slightly lower in brightness (value). The canines (third teeth from midline) have greater intensity or saturation of color (chroma). First and second premolars (teeth behind canines), which are lighter and brighter than the canines, are similar in color to that of the lateral incisors.

When evaluating the color of your teeth, your dentist examines how closely matched your upper and lower teeth appear. Both sets of teeth should look similar and complement your hair, skin and eye color. For best results, color/shade reproduction in anterior restorative and cosmetic treatment should come close to natural esthetics, rather than merely opting for the lightest, brightest shades. Shade guides are used to evaluate optimal color prior to teeth whitening.

Tooth Proportion. Most people perceive a pleasing smile as one in which the two central front teeth are dominant and have a width-to-length ratio of 75 to 80 percent. This proportion guides the length and width of other teeth in the esthetic zone (the section of upper and lower teeth that show when you smile), making your smile appear balanced or symmetrical.

Long teeth equate to a younger-looking smile. Over the years, normal wear and tear has a shortening or aging effect on your teeth and overall appearance. Teeth


length also may play a role in facial contouring. For instance, long, square-shaped teeth on a plump, round face creates a slimming effect.

Significance of golden proportion : Levin used the golden proportion to relate the successive widths of the anterior teeth as viewed from the frontal.[5,6,7]

Levin stated that "the width of the central incisor should be in golden proportion to the width of the lateral incisor and that the width of the lateral incisor to the width of the canine should also be in golden proportion as should the width of the canine to the first premolar.

§ The width of the central incisor should be multiplied by the value defined as the golden proportion, which is 0.618, or approximately 62%. The resultant width of the lateral incisor should be multiplied by 62% to give the width of the canine as viewed from the frontal.

§ The four front teeth, from central incisor to premolar are the most significant part of the smile and they are in the Golden Proportion to each other. This phenomenon has been combined in a grid which can be used to assist us in perfecting the aesthetics of the eight front teeth.

Recurring esthetic dental (red) proportion

§ The RED proportion states that the proportion of the successive widths of the teeth as viewed from the frontal should remain constant as one move distally.[8] Rather than being locked into using the 62% proportion, the dentist can use the proportion of his or her own choosing as long as the dentist is consistent while moving distally. Instead of having to accept the proportion already defined by the widths of the central and lateral incisors, the dentist can define his or her desired RED proportion.

§ The use of RED proportion gives greater flexibility. Although an approximate 70% RED proportion is preferred, the RED proportion should be modified to fit the face, skeletal structure, and general body type of the patient

Tooth Texture and Characterization. Cosmetic dentists can use their artistic skill and clinical experience to characterize restorations to create a more feminine (meaning, smaller, smoother, oval- or round-shaped) or masculine (meaning, larger, square-shaped, blunt) appearance. Apart from matching or enhancing the look, feel and function of your natural teeth, cosmetic dentists also can correct imperfections, such as chips or cracks.

Teeth Angulation. Teeth should have a symmetrical appearance in the front and a balanced appearance in the back. Teeth should not project out too much or be set too far in; they should not be crooked, overgrown or uneven. When the upper front teeth tip toward the midline, the overall esthetic effect is a harmonious one in relation to the lower lip and, more importantly, to the midline.

Proper occlusion – the relationship between the upper (maxillary) and lower (mandibular) teeth when they come into contact on biting or chewing – is critical. In addition to affecting the looks, the chewing surfaces of the teeth come together also impacts the other teeth, gums, neck and head, jaw muscles and joints and the overall oral health of the patient.

Incisal Edge Position

The incisal edge position – how far down/long the top two middle teeth are – sets the stage for the proportions of the rest of the smile and smile line. Apart from serving an important esthetic function, the incisal edge position is vital to proper function, in addition to speech and making sounds that start with "F" and "V", for example.

Gingival Tissue

Gum tissue should look healthy (meaning, no red, puffy or bleeding gums). Gingival contour is the shape or form of the gums around the necks of the teeth. The "ideal" smile should not show more than three millimeters of gums between the incisal edge and the bottom of your upper lip. The shape of the gums of the lower incisors and the upper laterals should be a symmetrical half-oval or half-circular shape. The upper centrals and canines should show a more oval, or elliptical, shape to the gums.

Buccal Corridor

The buccal corridor is the dark space visible between the corners of the mouth and the upper teeth. Research

indicates that, under most circumstances, individuals with considerably smaller buccal corridors (broader smiles) are thought to have the "best" or "most attractive" smiles. Women, in general, have significantly broader smiles, increased tooth arcs and reduced tooth/lip arc differences than men.

Emergence Profile

A tooth's emergence profile is the angle at which the tooth emerges from the gums when viewed from the side. This can affect the fullness of a person's smile, as well as provide lip and cheek support. Greater fullness avoids a caved-in look to the face, giving a more youthful and attractive appearance.

Other Smile Anatomy Considerations

A smile's impact cannot be determined just by the beauty of individual teeth and gums. Each patient is unique, varying by age, sex, looks, personality traits, and esthetic needs and expectations.

The "ideal" smile also must take into account individual considerations such as facial features, skin tone, hair color, and how the size, color and condition of your teeth, as well as gum tissue and lips, fit in with your overall physical appearance. In addition, occlusal and functional considerations may influence the smile design in both natural and restored teeth, and may affect the longevity of cosmetic treatment.

Macroesthetic concepts provide only guidelines and reference points for beginning esthetic evaluation, planning and treatment. The artistic component of dentistry – especially for cosmetic dentistry – can be applied and perfected by dentists who understand the rules, tools and strategies of smile design. With today's modern technology, such as digital imaging, lasers, whitening procedures and the like, dentists can create smile design makeovers with procedures and techniques that range from minimally invasive whitening and composite bonding, to porcelain veneers, crowns and dental implants. Additionally, they can use soft tissue augmentation via dermal filling agents to correct facial aspects such as thin lips and asymmetrical facial appearances to increase a smile's attractiveness. Advances in dental spa dentistry and sedation dentistry make it possible to do these procedures with less patient anxiety and pain.

Yet smile makeovers, like beauty, ultimately are in the eyes of the beholder. Just because they can be done does not mean they need to or should be done. The esthetics of cosmetic dentistry may think that his or her unique dental quirks are characteristics to be embraced rather than corrected.

Conclusion

The cumulative visual impact of the smile cannot be associated exclusively with the beauty of individual teeth. The microesthetics of natural and restored dentitions must be combined with macroesthetic considerations. Smile design is a relatively new discipline in the area of cosmetic dentistry, and it involves several areas of evaluation and treatment planning. Macroesthetic principles are only part of the overall picture; gingival esthetics, facial esthetics and microesthetics are the other three essential components of effective smile design. In addition, occlusal and engineering issues also may alter the smile design in both natural and restored dentitions and could influence the longevity of cosmetic treatment. It should not be forgotten that each patient is unique, representing a special blend of age characteristics and expectations, as well as sex and personality specificity. Macroesthetic concepts provide only guidelines and reference points for beginning esthetic evaluation, treatment planning and subsequent treatment. The artistic component of dentistry—and articularly of cosmetic dentistry—can be applied and perfected by dentists who understand the rules, tools and strategies of smile design.

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Delayed presentation of temporomandibular joint ankylosis and management

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Abstract

Intra capsular ankylosis results from fusion of condyle, disk and fossa complex as a result of formation of fibrous tissue, bone fusion or combination of two. The ankylosis in growing children adversely effects the growth and development of jaw causing facial deformity, impairment of speech, difficulty in mastication with severe psychologic burden on the child. Ankylosis requires detailed pre operative evaluation of type and extent of deformities in such patients can be corrected at the earliest obtaining desired result.

Introduction

Temperomandibular joint is a finely balanced structure with high degree of anatomic precision. The definite cause of ankylosis is not known. The two main factors predisposing to ankylosis are trauma and infection in or around the joint region. Topazian reported that 26 to 75% of cases of Tempero-mandibular ankylosis are seen following trauma while 44 to 68% are seen due to infection.[1] Kaban classified ankylosis as true or false, any condition that give rise to osseous or fibrous adhesion between the surface of temperomandibular joint is true ankylosis as compared to false ankylosis which result from pathological condition not directly related to joint.[2] In western literature incidence is decreasing due to better understanding of management of condylar fracture and also to decreased incidence of middle ear infection following the introduction of antibiotics. But in India the incidence of temperomandibular ankylosis is still high.[1] The temperomandibular joint protocol suggest early surgical intervention, elaborate resection, early mobilisation and aggressive physiotherapy.[3]

Case report

A 23-year-old presented to Department of oral and Maxillofacial Surgery, M.E.S Dental College, Perinthalmanna, Kerala, with a complaint of inability to open the mouth. The patient gave a history of reduced mouth opening since childhood. In history the contributory factor was the otitis media on the right ear during childhood.

On clinical examination patient's mandible was micrognathic, a typical bird face deformity with receding chin was seen. Antegonal notch is well defined bilaterally. Upper incisors are protrusive with anterior open bite. The mouth opening recorded was 3 mm. Maxilla was narrow. Multiple caries tooth with bad periodontal condition was see (fig 1, 2). The patient was advised OPG, CT scan of the joint. The radiographic finding was complete obliteration of the joint space with dense sclerotic bone. Bone around the neck of condyle become continuous with the base of the skull coronoid process is elongated (fig 3).

The diagnosis was bilateral ankylosis made from history, clinical findings and radiological findings. Surgical plan was gap arthroplasty with interposition of temporalis muscle and fascia along with bilateral coronoidectomy followed by aggressive physiotherapy as stage I. Stage II required correction of mandibular deformity. The procedure was done by blind nasal intubation. Bilateral gap arthroplasty was done at the level below the joint space with the gap of 1 cm. interposition of temporalis muscle and fascia was placed in the gap to prevent the risk of recurrence (fig 4, 5). Bilateral coronoidectomy was done at the level of sigmoid notch till the anterior border of the ramus. Mouth opening was checked and it was recorded as 35 mm (fig 6). Post operative recovery was uneventful. Patient was advised post operative physiotherapy for 6 months. Second stage of the surgery will be done to correct the mandibular retrusion so as to improve the facial deformity.

Discussion

Kaban et al have presented an approach for the management of the ankylosed joint that include complete resection of abnormal bony segment with aggressive debridement especially at the anteromedial aspect of fossa where removal of bone are typically missed.[2] This procedure is followed by ipsilateral and possibly contralateral coronoidectomy depending upon the degree of mobility after resection. The intermaxillary fixations used for short period followed by closely

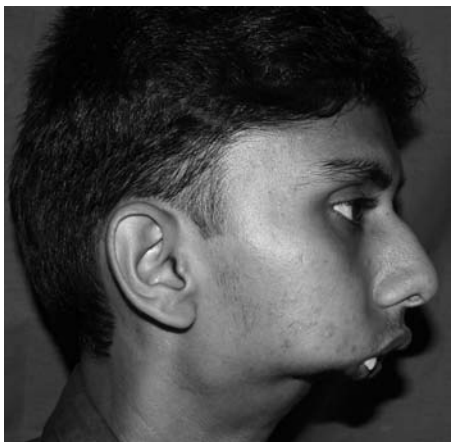

Fig. 1

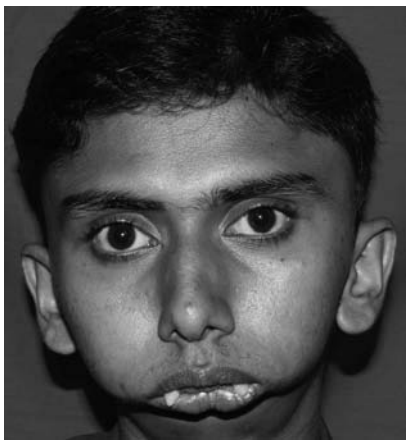

Fig. 2

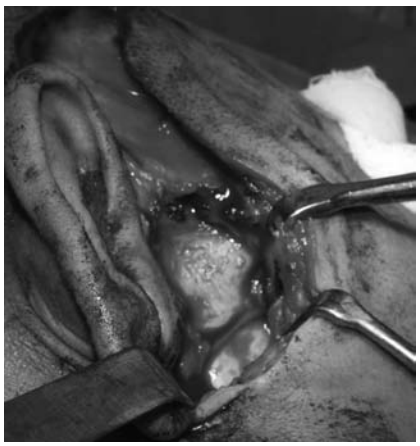

Fig. 4

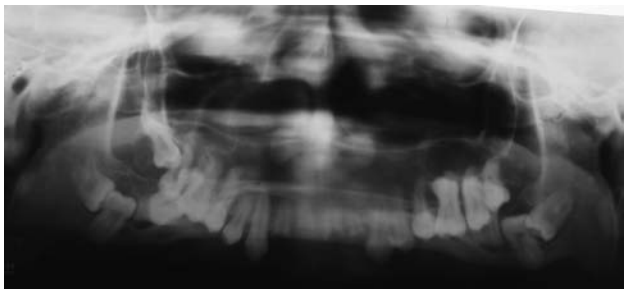

Fig. 3

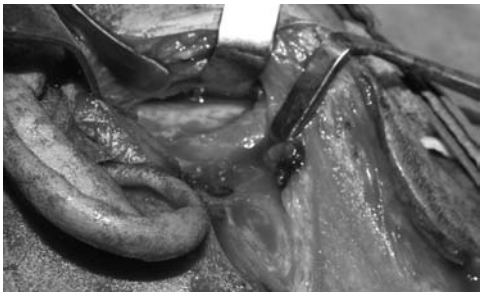

Fig. 5

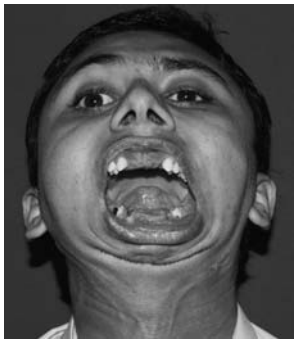

Fig. 6

monitored aggressive regimen of physiotherapy over 1 year period.

Retrospective examination showed that asymmetry treated had remained corrected throughout the follow up period and at the one year evaluation average of 292 % more than the preoperative values (16.5 mm vs. 13.5mm)[2] Knowledge of regional anatomy and improved techniques for surgical access to temperomandibular joint have greatly reduced complication rates.[3] Thus with correct surgical treatment and post operative physiotherapy enables the patient to normal functions.

Conclusion

Ankylosis is a disease of the jaw which requires detailed preoperative evaluation of type of extent of deformity. Surgical procedures require aggressive resection with adequate gap and inter positioning so as to prevent recurrence. Physiotherapy for 6 months to 1 year is to be given to maintain the mouth opening. Second stage surgery is planned to correct facial deformity. So with proper diagnosis, surgical treatment and physiotherapy normal function and facial esthetics can be improved.

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Management of gingival recession using free mucosal autograft

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Abstract

Aim: The purpose of this study was to assess the success and predictability of root coverage obtained with free mucosal autograft in the treatment of class III gingival recessions in South Indian Population for a period of six months. Materials and Methods: Eight patients contributed to twelve sites, each with class III recession in lower anterior region. Clinical parameters recorded at baseline and at 1 and 6 months were pocket probing depth (PD), clinical attachment level (CAL), recession depth (RD) and width of keratinized tissue (KT). Results: Reduction of recession resulted in a significant gain in CAL and PD at the end of six months. A statistically significant mean root coverage of 53.1% was obtained at the end of six months. A statistically significant improvement in the width of keratinized tissue (KT) was also observed after a six month follow-up period. Conclusion: In a south Indian population, class III gingival recessions treated with free mucosal autograft procedures resulted in 50% root coverage.

Introduction

Gingival Recession is exposure of the root surface due to apical shift in the position of gingival margin. The number of patients seeking treatment for Miller's Class III recession is at increase among South Indian population. The predominant goal of therapy in this patient group is functional restoration of periodontal attachment apparatus rather than esthetics.

Since the use of subepithelial connective tissue is technically challenging, free mucosal autograft is still the predictable procedure for management of class III gingival recession. Miller[1] demonstrated the applicability of the free gingival graft technique for root coverage. Bjorn[2] published the first photographic evidence and Nabers[3] introduced the term free gingival graft. The free gingival graft technique used tissue removed after performing gingivectomy. Instead of discarding the resected gingiva it was used as the donor tissue. This technique was later modified and palatal tissue or masticatory mucosa was used as the primary donor source instead of gingiva (Pennel).[4]

Anatomical factors such as aberrant frena, muscle attachment and gingival phenotype are also thought to contribute to the etiology of gingival recession. Racial[5] variation in the gingival phenotype has been demonstrated with the south Indian population exhibiting the thinner phenotype.[6] Muller and Eger proposed that individuals with thin phenotype are more prone to develop gingival recession and gingival bleeding. Poor oral hygiene is a well-recognized risk factor for periodontal diseases. Lack of awareness and socioeconomic factors are thought to contribute to oral hygiene practices or the lack of it that persists in the ethnic south Indians that comprises our study population. This study was instituted to assess the predictability and success of free mucosal autograft in the management of class III recession in South Indian population.

Materials & Methods

Eight patients (four females & four males) with 12 sites having class III recession aged between 20-40 years were selected from Dept. of Periodontics, Thaimoogambigai Dental College, Chennai. Clinical parameters pocket probing depth, clinical attachment level, recession depth and width of keratinized tissue were assessed at baseline, postoperatively at one month and six month intervals. The patients agreed to the study protocol and informed consent was obtained prior to treatment.

Selection criteria:

1) Presence of Miller's class III gingival recession involving lower incisors, 2) Absence of severe cervical abrasion/root caries, 3) Absence of abnormal frenal attachment, 4) Patients who are nonsmokers, 5) Patients with no contraindications for periodontal surgery.

Clinical recordings

Initial therapy comprised of scaling and root planning and oral hygiene instructions were reinforced. Prior to surgery, all selected sites presented a healthy periodontium with the gingiva exhibiting no evidence of bleeding on probing (Fig. 1). The following measurements were taken at the mid-buccal aspect of each tooth at baseline, 1 month, 6 months post-surgery.

1. Probing pocket depth (PPD) was measured with a standard periodontal probe to the nearest millimeter from the gingival margin to the bottom of the sulcus.
2. Clinical attachment level (CAL) was measured from cemento enamel junction to the bottom of the sulcus.
3. Recession depth (RD) was measured at mid-buccal point from cemento enamel junction to the gingival margin.
4. Width of keratinized tissue (KT) was measured at mid-buccal point from the gingival margin to the mucogingival junction.

Impression of the maxillary arch was taken to prepare the acrylic palatal stent.

Surgical procedure

The surgical procedure was carried out by placing the first incision at the mucogingival junction. The vertical incisions were made in the interproximal sites distal to the terminal teeth to form a right angle with the initial incisions

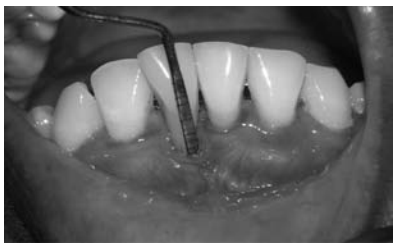


Fig-1 Preoperative Photograph showing class III recession

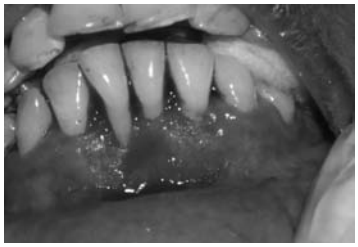


Fig-2 Preparation of the recipient site

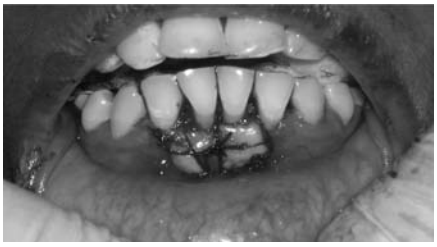
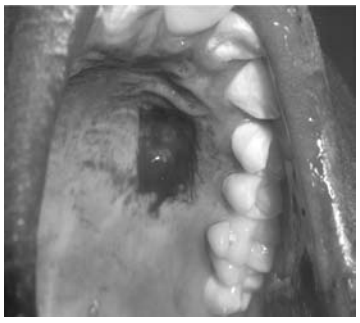


Fig-4 Free Mucosal Graft stabilized using sutures



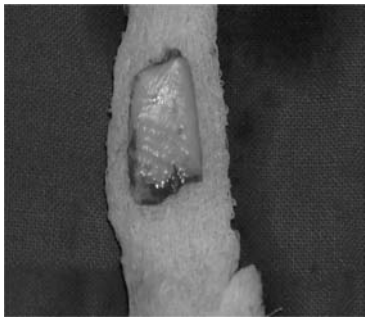


Fig-3 Free mucosal Graft obtained from palate

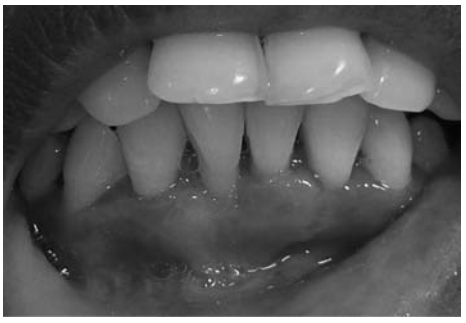
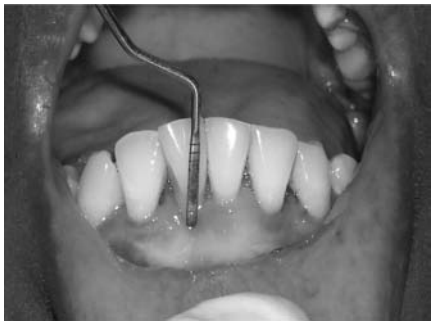


Fig-5 One Month Postoperative view



(Fig 2). A partial thickness flap was raised and excised. Thus a 3-4 mm wide recipient bed was prepared apical and lateral to the recession defect. An aluminum foil template of the recipient site was made and placed over the donor site in the palate. The graft was harvested from palate between bicuspid and 1st molar area. (Fig3) Care should be exercised to avoid the greater palatine foramen area due to potential bleeding and paresthesia The harvested free mucosal graft was secured in the recipient site with interrupted sutures and horizontal mattress stabilizing sutures anchored around the cervical constriction of the tooth were placed over the graft to assure intimate contact between the graft and the recipient bed (Fig 4). Periodontal dressing was placed over the graft. Acrylic palatal stent was placed in the donor site to protect the site against trauma and disruption of blood clot.

Postoperative care

The patients were prescribed 0.12% chlorhexidine rinse twice a day for 4 weeks. Antibiotics and Analgesics were administered as needed. All the patients were examined weekly for the first month and thereafter oral hygiene was maintained with supragingival scaling every three months till the end of study period.

Statistical Analysis

Mean and standard deviation were estimated for different variables at various time points. Mean values were compared between different time points by using wilcoxon Signed Rank Sum Test. In the present study, $p<0.05$ was considered as the level of significance

Results

All sites healed uneventfully, without complications except for mild inflammation associated with the treated sites.

Changes in clinical parameters

Overall findings at 1 and 6 months postsurgery showed that favorable results were obtained using FGGs in the treatment of class III gingival recession.

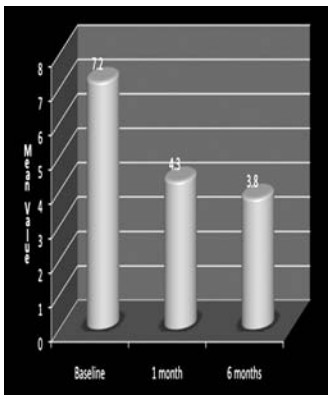
Mean and standard deviation of baseline, 1 and 6 months postoperative parameters (n=11 sites). At base line, probing pocket depth (PPD) of 2.5±1.0 mm, CAL of 7.2±1.5 mm, RD of 4.7±1.2 mm and KT of 0.2±0.5 mm were recorded.

At the end of 1 month, the mean PPD was reduced from 2.5±1.0 mm to 1.8±0.6 mm. There was gain in CAL from 7.2±1.2 mm to 4.3±1.0 mm. There was mean reduction in RD from 4.7±1.2 mm to 2.6±1.0 mm and the width of KT increased from 0.2±0.5 mm to 4.8±1.0 mm

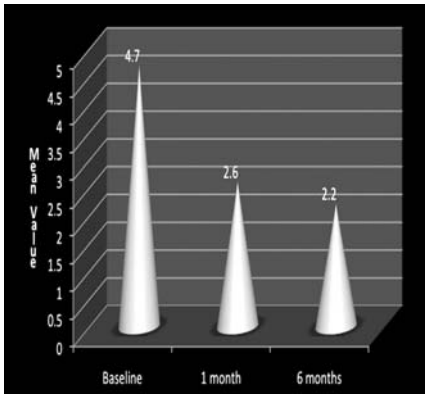
Statistically significant gain in clinical attachment level ($P<0.02$) [table 1 & graph 1], reduction in RD ($P<0.02$) [table 2 & graph 2] and increase in the width of keratinized tissue [table 3 & graph 3] were attained at 1 and 6 months. The mean root coverage was 45.0% at 1 month and 53.1% at 6 months.

Discussion

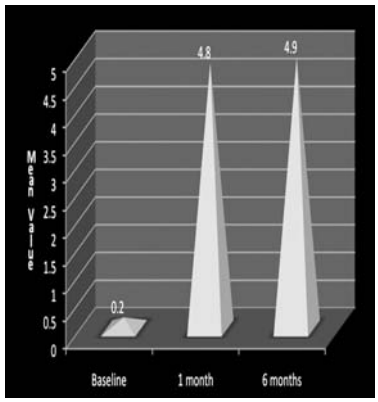
The predictability of root coverage procedures is dependent on several factors such as anatomical factors, surgical skill of the operator and postoperative



Graph-1 *Comparison of CAL Between Different Time Points*



Graph-2 *Comparison of Mean Recession Depth Between Different Time Points*



Graph-3 *Comparison of Mean Keratinized Tissue Between Different Time Points*

maintenance of patients. The factors associated with the survival of free mucosal autograft over the denuded root surface depends on diffusion of plasma and subsequent revascularization from those parts of the graft resting on the connective tissue bed surrounding the dehiscence and the establishment of collateral circulation from the graft bed by the healing phenomenon of bridging (Sullivans & Atkins) 1968).[7]

Root coverage can only be expected to occur to the level of the interdental gingival tissue. In cases where narrow or loss of interdental papilla were present consideration should be given to increase the bed preparation in the apicocoronal direction in order to increase the vascular - avascular ratio in the recipient site. The characteristic of the incision at the recipient site are also important means to optimize blood supply to the graft. Horizontal and vertical incisions should be made at 90 degree angle, in a butt joint fashion. Beveled incisions may result in the tendency of the graft to slide over the incision lines with resultant dead space between the graft and graft bed and therefore, blood supply may be compromised.

The vertical incisions in the recipient site should be placed close to the line angles of the adjacent teeth in order for wide interdental papillae to be present and consequently facilitate suturing and maximize blood supply from the papillary areas. The dimension and border characteristics of the graft itself will also impact root coverage success because they affect blood flow. The butt joint present along the incisions of the recipient site should also be present on the graft so that vascularity can be established immediately after suturing. Therefore beveled border should also be avoided in the donor tissue. A meticulous suturing technique will promote stabilization and immobilization of the graft and prevent it to be dislodged in the course of healing. Lack of good adaptation between the graft and underlying vascular and avascular portion of the recipient site or its borders may result in necrosis of the grafted tissue. The use of periodontal dressing during the two postoperative weeks will also prevent adverent trauma to the graft.

Previous studies[8] have reported root coverage of 40-70% using free mucosal autograft in class I and II recessions. The loss of crestal alveolar bone and interdental soft tissue precludes the possibility of 100% root coverage in class III gingival recession.[9] There is paucity of literature regarding management of class III recession, there is insufficient evidence to characterize the factors involved in the success of this procedure. In our study 45-50% of root coverage was obtained which is similar to the results of previous study (Remya et.al.)[10] The greater loss of interdental hard and soft tissue in our study population could be the reason for relatively lesser degree of success obtained by using free mucosal autograft.

Although Miller[1] proposed that free mucosal autograft is a predictable procedure for root coverage, the obvious disadvantage of color match and donor site morbidity render it not suitable for use as root coverage procedure. However even with the advent of subepithelial connective tissue graft and allogenic grafts like alloderm, free mucosal autograft still continues to be the predictable method to increase the apico-cironal dimension of keratinized mucosa. For many years the presence of an adequate amount of gingiva was considered a key stone for the maintainance of periodontal health.[11] In an observational study, Lang and Loe[12] suggested that 2mm of keratinized gingiva is an essential prerequisite for periodontal health. Other investigators failed to find a similar association and reported that it is possible to maintain healthy marginal tissues even in areas with a reduced or missing keratinized gingival.[13-15] An increase in the width of the keratinized tissue was observed in our study. However, the presence of site related conditions like gingival recession, thin periodontium and root prominence combined with a reduced or missing amount of attached gingiva may indicate gingival augmentation procedure.[16] Based on the existing evidence, the American Academy of Periodontology suggested several indications for gingival augmentation procedures: to prevent soft tissue damage in the presence of alveolar bone dehiscence during natural or orthodontic tooth eruption; to halt progressive marginal gingival recession; to improve plaque control and patient discomfort around teeth and implants; and to increase the sufficient dimension of gingival in conjunction with fixed or removable prosthetic dentistry.[17]

The limitations and disadvantages of the free mucosal autograft for root coverage include increased discomfort and potential postoperative bleeding of the donor site. In our study the bleeding from the donor site was controlled

Table 1: *Comparison of mean CAL between different time points*

Time points compared	Mean ± S.D	Change Mean ± S.D (% change)	P- Value
Baseline 1 month	7.2 ± 1.5 4.3 ± 1.0	2.8 ± 1.0 (39.0 %)	0.002 (Sig)
Baseline 6 months	7.2 ± 1.5 3.8 ± 0.9	3.4 ± 1.0 (47.3 %)	0.002 (Sig)
1 month 6 months	4.3 ± 1.0 3.8 ± 0.9	0.6 ± 0.7 (12.6 %)	0.02 (Sig)

by placing the periodontal dressing on the acrylic palatal stent which was inserted to cover the wound. The stent was placed before placing the graft at the recipient site. If only gauze is placed over the wound until the graft is sutured at the recipient site then the initial clot will be disturbed when the gauze is removed

In our study 50 to 60% of the patients had thin and scalloped biotype. This finding agreed with the concept that patients with thin periodontal biotypes were more prone to dehiscences.[18] Our study showed that the gingival margin had shifted coronally 2 months after surgery in 2 sites. This modality of healing is attributable to Creeping attachment, which is a postoperative migration of the gingival margin tissue in a coronal direction over portions of previously denuded root occurs following placement of free mucosal autograft (Matter).[19]

The free mucosal autograft used in this study accomplished

1. Reduction in pocket probing depth and gain in the clinical attachment level.
2. Reduction in the recession depth.
3. Increase in the keratinized tissue.

The results of the study also showed the stability of the root coverage even after 6 months. The greater loss of interdental hard and soft tissue in our study population could be the reason for relatively lesser degree of success obtained by using free mucosal autograft. The results indicated that while the complete root coverage was not possible, nearly 50% of the denuded root surfaces could be covered with FGGs in class III recession, contributing to an overall improvement in the periodontal health. The establishment of a stable and maintainable periodontium was the primary focus of this procedure.

Table 2 : *Comparison of mean Recession depth between different time points*

Time points compared	Mean ± S.D	Change Mean ± S.D (% change)	P- Value
Baseline 1 month	4.7 ± 1.2 2.6 ± 1.0	2.1 ± 0.8 (45.0 %)	0.002 (Sig)
Baseline 6 months	4.7 ± 1.2 2.2 ± 0.9	2.5 ± 1.0 (53.1 %)	0.002 (Sig)
1 month 6 months	2.6 ± 1.0 2.2 ± 0.9	0.4 ± 0.7 (13.9 %)	0.06 (N.S)

Table 3 : *Comparison of mean Keratinized tissue between different time points*

Time points compared	Mean ± S.D	Change Mean ± S.D (% change)	P- Value
Baseline 1 month	0.2 ± 0.5 4.8 ± 1.0	4.5 ± 1.2 (333.3 %)	0.002 (Sig)
Baseline 6 months	0.3 ± 0.5 4.9 ± 1.2	4.7 ± 1.4 (333.3 %)	0.002 (Sig)
1 month 6 months	4.8 ± 1.0 4.9 ± 1.2	0.2 ± 0.4 (3.1 %)	0.16 (N.S)

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Prosthetic rehabilitation of a patient with hemi-maxillectomy with oro-facial defect

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Abstract

Malignant Tumours of the maxilla and mandible requires either surgical removal, chemotherapy or radiotherapy of the particular lesion. Cosmetic deformity with functional problems namely mastication and speech has been the major drawback in surgical excision. This clinical report describes the prosthetic rehabilitation of a patient with left hemimaxillectomy due to adenocystic carcinoma involving the left maxillary sinus and left orbital floor. Thus resulting in a direct communication from oral cavity to floor of the orbit along with the facial defect. The prosthesis was designed for the left maxillary edentulous arch for satisfactory retention by the cast partial denture with hollow acrylic bulb obturator intraorally and closure of the facial defect with silicone prosthesis.

Introduction

According to World Health Organisation statistics, individuals of the Indian subcontinent have the highest prevalence of orofacial carcinoma. Surgery, radiation, chemotherapy or combination therapies are commonly administered treatment modalities for treatment of oral malignancy. Surgical resection can be mutilating, disfiguring and may deeply affect self-image and self confidence of patients. Orofacial defects have unique limitations and challenges. A coordinated effort from the oral surgeon, oral physician and the maxillofacial prosthodontist to treat such patients is needed. Maxillofacial prosthesis is a branch of medical and dental science which aims to protect and directly or indirectly, restore structures that are injured or lost, congenital or acquired means beyond the limits of a usual prosthesis which restores the teeth and the alveolar ridges. The field of maxillofacial prosthesis is not new. It dates back to the time before recorded history, but its recognition as a science took place during the time of the first world war. It has progressed so that, with the new materials which are presently available, it is possible to make life-like skin matching prosthesis. This article illustrates the step by step procedure for the prosthetic rehabilitation of an oro-facial defects. Prosthetic rehabilitation restored the function, esthetics, phonetics and psychological set back, thereby improving the quality of life of the patient.

Case report

A male patient aged 52 yrs visited our department complaining of facial deformity on the left side of the face and food entering into the nasal cavity. On taking his complete history it was known to us that he was treated for adenocystic carcinoma involving the left maxillary sinus and left orbital floor and surgical resection was made. The patient's previous prosthesis was ill fitting and didn't provide adequate fullness to the defect side.

Clinical examination

On clinical examination it was noticed that due to hemi-maxillectomy, it had lead to the direct communication from oral cavity to the floor of the orbit. Intra oral defect measuring about 3cm x 5cm in dimension (fig 1). Right and left partial edentulous arch with 11 to 27 missing teeth. A facial defect below the orbit, measuring about 1cm x 2cm in dimension, opening into the oral cavity (fig 2). Thus leading to impaired speech pattern and obvious facial deformity.

Materials and methodology

Once the complete analysis of the patients past medical and dental history was known maxillary and mandibular preliminary impression were made with quick setting irreversible hydrocolloid impression material. Then the diagnostic cast was poured and a special tray was fabricated for the maxillary cast with autopolymerizing resin. To provide good retention and stability metal denture base was our treatment of choice. Surveying of the maxillary partial edentulous cast was done. Accordingly tooth preparation was done. Then secondary impression was made with elastomeric impression material (3M). Master cast was poured and a wax pattern was done for the metal frame work by blocking out the maxillary defective area. Once the metal denture base was fabricated then jaw relation was done. A metal tag was made in the palatal aspect of the metal denture base. Wax Try–in was done and checked for the esthetics and retention of the metal framework. Acrylization was done with heat cure acrylic resin

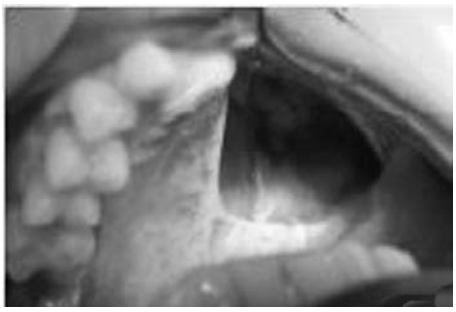

Fig 1. Intra Oral defect

Fig 2. Facial defect

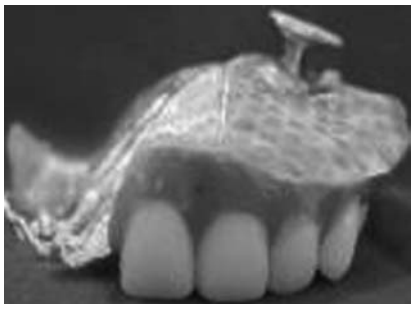

Fig 3. Acrylization

(Ivoclor veined) (fig.3).

Next step was carried out by making impression of the maxillary defect area. According to Desjardins, there are five intrinsic areas within and around the defect that can provide retention for the obturator. These areas include the residual soft palate, the residual hard palate, the anterior nasal aperture, the lateral scar band and the height of the lateral wall. Impression of intraoral defect was made to obtain adequate facial fullness and symmetry with heavy body elastomer (fig.4). The metal tag helps to retain the impression material to the denture base.

Impression bulb was then cut into upper and lower halves. Again the lower half was split into 4 quarters for the ease in removal of the impression from the metal tag without any distortion of the impression. Flasking of upper and lower halves was done separately, deflasking and packing was done with heat cure acrylic resin (Ivoclor veined). Then the acrylic bulb was trimmed into a hollow shell (fig.5), the metal plug was also removed to reduce the weight of the prosthesis and then two halves shells was fused with autopolymerizing resin and thus a single hollow acrylic bulb obturator was fabricated. It was checked in patients mouth for esthetics, phonetics and there was no seepage of fluids into the nasal cavity.

Silicone facial defect closure

Once the obturator is placed intraorally patient has obtained adequate facial fullness and symmetry. Then the sectional impression of the defective extraoral site impression was made.

Impression compound is made as the rim and placed around the defect area in order to confine the borders of the impression. Irreversible hydrocolloid impression material was used to take impression and stabilized with gauze and type II gypsum material (fig.6). Cast was made. Wax pattern was made and wax try- in was done. Following which flasking and dewaxing was done.

Once the appropriate shade of the Silicone (Cosmosil) was selected, the silicone was packed in the dewaxed mold space. The whole unit was allowed for bench curing for 24 hrs. After 24 hrs the packed mold was placed in hot air oven at 150O F for 90 mins and the temperature was raised to 200 O F for 20mins. The processed silicone was obtained and finished with glaze.

Silicone facial prosthesis was then placed in the patients facial defect area and was checked for its fit and shade. The undercuts were used for the retention of the prosthesis and adhesive was used to fuse the silicone prosthesis in defect site (fig.7). Patient was satisfied in his esthetics, function and speech pattern.

Discussion

Surgery, radiation and chemotherapy are used in the management of orofacial cancers. Surgical resection often creates large defects accompanied by dysfunction and disfigurement. Speech, swallowing, inability to control saliva secretions and cosmetics can be adversely affected. A Hemi surgical excision of the maxilla along with radiotherapy was the treatment of choice for this adenocystic carcinoma. Hollow bulb obturator that was planned for this patient has many advantages like weight of the obturator is markedly reduced. It helps in acceptance of the obturators as it decreases the self-consciousness of the patient for wearing the denture, helps in swallowing by decreasing pressure in the surrounding tissues and also in achieving retention. New methods are adopted to make the hollow bulb. One of the methods is to make the hollow bulb with light cure denture base acrylic resin, which was then covered with soft tissue liner material. It provides good seal and retention simultaneously. Another method is hollow bulb is made with silicone material which is more easy to fabricate. Danger of leakage and discolouration can be safely avoided using silicone.

Summary

The management of a patient with carcinoma does not conclude with elimination of the disease but continues with rehabilitation of function, restoration of esthetics and prevention of infection and maintenance of proper oral hygiene.

A planned coordination among the oral surgeon, oral physician and the prosthodontist is essential preceding the surgery. This facilitates harmonization of

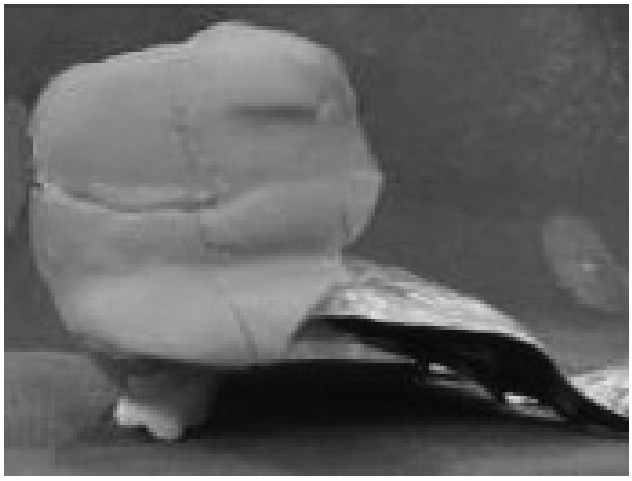

Fig 4. Impression of intraoral defect

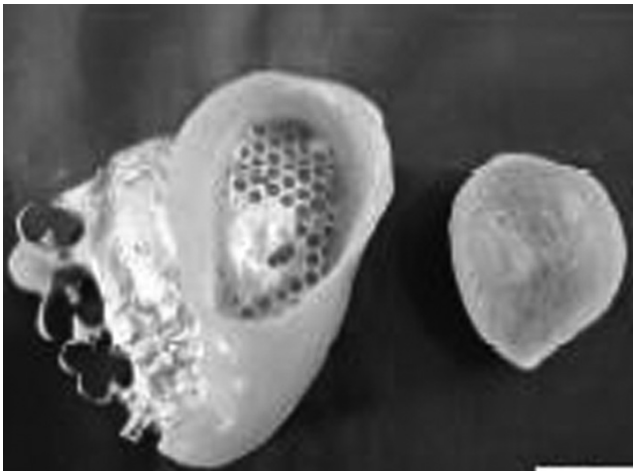

Fig 5. Hollow acryic shell

Fig 6. Impression of extra oral defect

Fig 7. Post treatment

the surgical techniques with the prosthetic procedures. The field of maxillofacial stomatoprosthesis has been, until recently, an unheralded section of the prosthodontic service in dentistry. It is a sincere hope that more institutions will provide this type of service and that more dentists will take an interest and realize the importance of this branch of dentistry as a healing art.

Every dentist with a little training and interest is fully qualified to undertake this type of work and help the afflicted by replacing anatomic deficiencies, restoring physiologic functions, correcting impaired speech, improving esthetics, and, in so doing, building up the patient's morale.

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Review

Plasma cell gingivitis of unknown etiology

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Abstract

Plasma cell gingivitis is a rare benign condition of the gingival characterized by sharply demarcated erythematous and edematous gingiva often extending up to the muco gingival junction. Though the exact etiology is not known, allergic reaction seems to be a plausible explanation. The histopathological appearance consists of a dense infiltration of normal plasma cells separated by a collagenous stroma. We discuss here a case of plasma cell gingivitis which has been diagnosed based on the presence of plasma cells in histological section and was treated with open curettage.

Introduction

Plasma cell gingivitis is a rare condition characterized by diffuse and massive infiltration of plasma cells into sub epithelial connective tissue. Clinically, it appears as a diffuse reddening and edematous swelling of the gingiva with a sharp demarcation along the mucogingival line. The cause of which is still not fully understood. The unknown condition is of undetermined origin and has been described in literature as "Atypical gingivostomatitis" or "Idiopathic gingivitis".[1] Mucosal hypersensitivity related to flavoring agents such as cinnamonaldehyde and cinnamon in chewing gums and dentrifices were also shown as etiological factors in development of plasma cell gingivitis.[2]

A case of plasma cell gingivitis is reported in the maxillary and mandibular anterior region. Here we document a case of plasma cell gingivitis of unknown etiology, regression and progression of gingival inflammation following treatment is also seen.

A 23 yr old male patient reported to the department of Periodontics, A.J. Institute of Dental Sciences, Mangalore, India with the chief complaint of swollen and bleeding gums in the front teeth. He had the problem of bleeding gums since 4yrs. Patient did not have any systemic bleeding disorders or allergic history.

Intraoral examination revealed the presence of minimal local factors. Missing teeth were 22, 36, 37, 38, 46, 48 due to dental caries. Physical examination of gingiva revealed pronounced changes in the maxillary and mandibular anterior region. All this comprised reddening and swelling of the gingival including both the marginal and the attached gingiva. Clinically, the patient appeared to have severe inflammation of the gingiva in the maxillary and mandibular anterior region.

Examination of the gingiva revealed generalized inflammation. Gingiva in relation to upper and lower anteriors was erythematous, soft and edematous with diffused gingival enlargement. There was generalized loss of stippling. Gingival was coronally placed in relation to upper and lower anteriors.

The OHIs score recorded was 1. Gingival index score was 3 which indicates severe gingivitis. OPG showed generalized horizontal bone loss extending up to the middle one third of the root. The diagnosis also required hematological screening and histological examination in addition to the clinical examination.

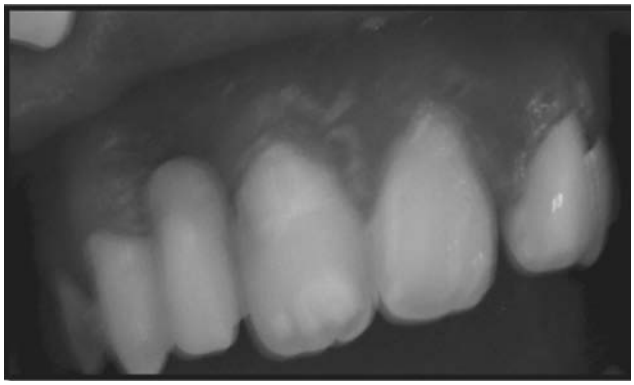
An excisional gingival biopsy in the region of 22 was carried to confirm the diagnosis as well as to exclude the other conditions.

The gingival biopsy showed stratified squamous epithelium with sub epithelial connective tissue. The deeper connective tissue showed a few granulomas made up of irregular clusters of epitheloid cells surrounded by lymphocytes, abundant plasma cells, macrophages and fibroblasts. A few scattered neutrophils, thin walled capillaries and a small foci of necrosis was seen. No cellular atypical present. On the basis of these findings, a histopathological diagnosis of plasma cell gingivitis was reported. The overall prognosis is fair.

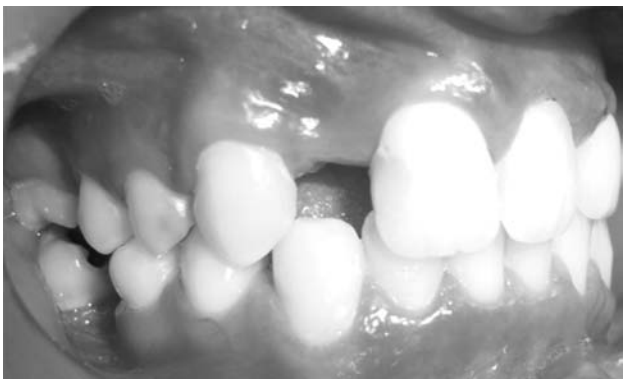
The initial phase for the treatment plan consisted of oral hygiene instructions, scaling and root planing followed by periodontal evaluation. Patient was recalled after 2 weeks for further treatment.

At the second visit, intraoral clinical examination revealed that the intense diffuse gingival erythema had persisted due to unknown etiology.

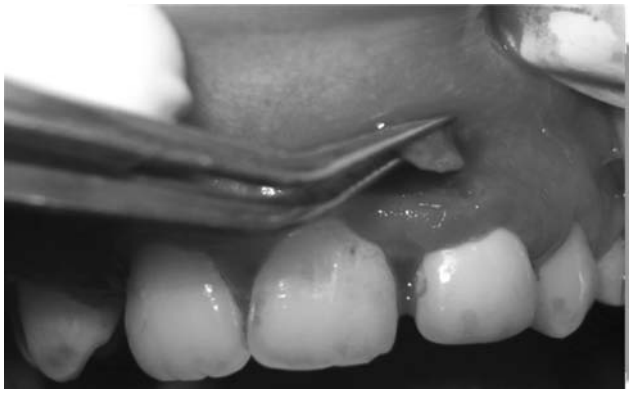
The patient returned for a re evaluation of his gingival



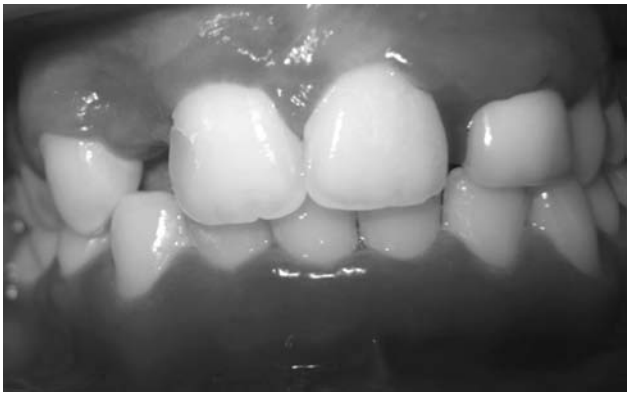
First visit



Following scaling and root planing



Tissue taken for biopsy



Before Internal bevel gingivectomy

condition 10 days after thorough scaling and root planing. Then, the internal bevel gingivectomy was carried out to contour the gingival margin and for de granulation in the lower anterior region. Upper anterior curettage was done. Analgesics and antibiotics were prescribed to the patient twice daily for 3 days. After a week, on intraoral examination gingival tissue showed satisfactory healing. On removal of pack, the gingival margin contour and consistency was also improved. After two weeks, there was almost healing of Upper and lower anterior region.

Discussion

Plasma cell gingivitis which was considered to be a highly uncommon, non neoplastic reactive lesions were brought to attention during the late 1960s and early 1970s.[3]

Bhaskar, Levin and Firch[4] first reported this pathological entity on gingiva and only a few case reports have been documented. Francis G. Serio et al[5] in 1971 focused that in United States during the period of 1968 to 1972, those people who used chewing gums reported with plasma cell gingivitis which regressed completely on discontinuation of the use of chewing gum. However, clinicians observed plasma cell gingivitis in non gum chewers also in which cause is unknown. The present case report is also with unknown etiology.

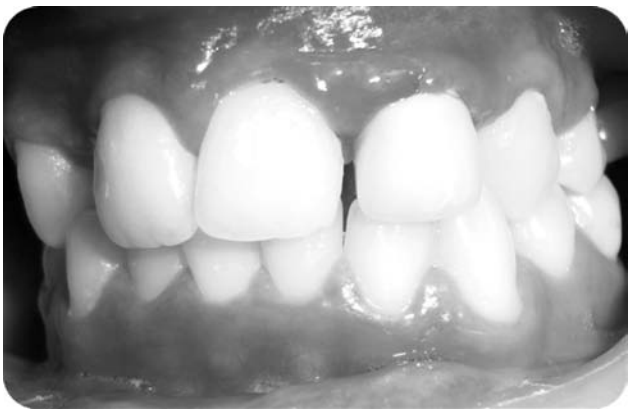
Plasma cell gingivitis is a rare condition characterized by massive infiltration of plasma cell into sub epithelial tissue. Clinically the illness presents as a diffuse enlargement with edematous swelling of gingival, particularly in Upper and lower maxillary and anterior region. Although exact mechanism is not known, it can be due to allergic reaction. Some authors have reported that it is an immunological reaction to allergens.

Garguilo et al[6] in 1995 studied Plasma cell gingivitis with 3 types.

1. allergen origin
2. neoplastic
3. unknown origin

The present case is considered to be type 3. Gargillo and Legman et al 1976 reported the case of Plasma cell gingivitis involving attached gingiva which strongly supports the current clinical status of this case.

In the present case minimal local factors was detected. Diffused gingival inflammation was present. This finding was inconsistent with plaque induced gingivitis that would normally involve the marginal gingival but not the entire width of attached gingiva.



After Internal bevel gingivectomy

Plasma cell gingivitis is an inflammatory condition wherein biopsy and histopathological studies must be performed to rule out the potential plasma cell dyscrasias and neoplasms including Multiple Myeloma. The diagnosis required hematological screening in addition to clinical and histopathological examination to exclude leukemia and lichen planus and mucomembranous pemphigoid.

The patient's medical history was unremarkable and he was systemically healthy. Also the histology of biopsy did not show agranulocyte sarcoma that would exclude other malignant diseases. In the present case, the plasma cell did not exhibit the nucleus atypia, histopathological analysis was consistent with a reactive non-neoplastic proliferation of plasma cells.

Conclusion

Plasma cell gingivitis is distinguished primarily based on the histopathological findings of massive sub epithelial infiltrate of epithelial cells even with various non surgical and surgical more of treatment seen to be recurring due to unknown etiology.

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Evaluation of tissue dissolving potential of diluted sodium hypochlorite solutions on human dental pulp: an in-vitro study

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Abstract

The concentration of sodium hypochlorite used in endodontics ranges from 0.5-5.25%. A higher concentration of sodium hypochlorite provide better tissue solvent activity, but it is more toxic to the vital tissues .This study assayed the PH and tissue dissolving ability of NAOCL solution ,when diluted either with double distilled water or 1% sodium bicarbonate solution using samples of human dental pulp tissues. Dilution of 4-6% stock sodium hypochlorite solutions with 1% sodium bicarbonate had the least PH value. Their dissolution potential was equal to undiluted 3% stock sodium hypochlorite solution. Dilution of 4-6% NaOCl with double distilled water showed least tissue dissolution time but the PH value was high.

Introduction

Sodium hypochlorite, a caustic solution used in endodontics as an irrigant should have a potential to dissolve the pulp remnants that are inaccessible to instruments. Sodium hypochlorite (NaOCI) is anti-microbial, dissolves tissue, as a weak bleaching property and has a lubricating action. It is a very useful irrigant as long as it is confined within the root canal system. The mechanical debridement is aided significantly by using chemicals with surface active, tissue dissolving, decalcifying property along with antimicrobial property. The choice of an irrigating solution depends on the complex anatomy, the state of pulpal disease and the type of microorganisms infected in the canal.

The sodium hypochlorite (NaOCI) solution used in endodontics would be either proprietary or a prepared solution made in the office. Office dilutions generally employ distilled water as a diluent although text and literature suggest sterile 1% sodium bicarbonate ($NaHCO_3$) solution as a diluent. The pH value of the prepared solution could vary according to the diluent.

There are numerous in vitro studies available on pulp tissue dissolution, pulp substitutions, on diluting of sodium hypochlorite (NaOCI), on stability of sodium hypochlorite (NaOCI), pH evaluation, smear layer removal and anti-microbial properties. A study to evaluate the effect of 1% sodium bicarbonate ($NaHCO_3$) solution as a diluent, was felt important to highlight the choice of endodontic irrigant.

The aim of this study is to assay the pH and tissue dissolving ability of sodium hypochlorite (NaOCCI) solutions, when diluted either with double distilled water or 1% sodium bicarbonates solution ($NaHCO_3$) using identical weight samples of human dental pulp tissue.

The objective of this study is to determine the type of diluent and the type of stock solution needed to make a sodium hypochlorite irrigant that could dissolve tissues in a short time. Two undiluted stock sodium hypochlorite (NaOCI) solutions were selected (3% and 4 - 6%) and two diluents, double distilled water and 1% sodium bicarbonate ($NaHCO_3$) was used to prepare 1% sodium hypochlorite (NaOCI) solutions. Along with these four diluted solutions, the 3% undiluted stock sodium hypochlorite (NaOCI) solution was used as a control. The pH value of both stock and prepared solutions were assayed by hand held pH meter. Two human tissues, dental pulp and umbilical cord were used to compare the tissue dissolution. The weight of pulp tissue samples were determined.

Sample kept in a beaker made in contact with 1 ml of solution for a minute. At the end of one minute the spent solution was aspirated and replenished with 1 ml of fresh solution to continue dissolution for another one minute. This process was repeated till the tissue was completely dissolved.

Groups

Following the pilot study, it was determined to have five test solutions in which one could be the 3% undiluted stock sodium hypochlorite solution itself. Three concentration types made with this stock solution; stock solution itself, diluted to 1% with 1% sodium bicarbonate ($NaHCO_3$) and double distilled water. They were designated for group I, II and V respectively.

Containers

Forty 25ml plastic containers with lid procured, disinfected and divided into groups of eight coded for five groups and two subgroups. These were used to store the samples of human tissues used in this study. 0.9% vol/wt normal saline was used as the storage medium and samples were stored at 40C between the procurement and experiment. 500 ml amber colored glass bottles were used to store the test irrigants.

Collection and storage of human dental pulp

The human dental pulps of single rooted teeth extirpated in bulk during endodontic therapy, were collected in coded containers. Forty such pulp tissue samples were collected and kept in coded containers after a brief wash in saline, stored in saline at 4 degree centigrade. Saline was used as the medium of storage since it will not have any fixative effect on the tissues.

pH Analysis of the test Irrigant solutions

The five different NaOCI solutions were tested for their pH value. The irrigant solution was poured into the glass beaker so that it was beyond the minimum level indicated in the pH meter. The pH meter was switched on and waited till a constant value was seen. The procedure was repeated and a mean of either two or four values was taken as the reading.

Sample tissue dissolution in the test irrigant solution of NaOCI

The pre-weighed human tissue samples were allowed to thaw at room temperature for 5 minutes. Then the tissue sample was transferred to a glass beaker and 1 ml of test irrigant solution was poured into it with a 2 ml syringe so that the tissue was fully immersed in it and the time was noted in a stop-watch. At the end of 60 seconds the solution was aspirated and a fresh 1 ml of solution was poured. The solution was stirred every 30 seconds and the process was repeated till the tissue got fully dissolved. The dissolution was considered complete when no visible tissue fragments were present in the glass beaker. The total time required for dissolution and the amount of solution consumed was logged on a table.

The statistical software SPSS PC+ (Statistical Package for Social Science, version 4.01) was used for statistical analysis.

Results

Table – A

pH of the undiluted stock sodium hypochlorite solutions	
3% Sodium hypochlorite	12.3
4-6% Sodium hypochlorite	13

Table – B

pH of the diluted 1% NaOCI solutions	
I	12.3
II	10.5
III	9.3
IV	11.3
V	11.9

Table – C

Group I - Undiluted stock 3% NaOCI
pH - 12.3
Group IA - Human dental pulp tissue

Sample No	Weight (grams)	Time of dissolution (min)	Amount of Solution Consumed (ml)
1.	0.3356	3	3
2.	0.2256	3	3
3.	0.3556	3	3
4.	0.5256	4	4
5.	0.2356	4	4
6.	0.1756	4	4
7.	0.1956	5	5
8.	0.5356	5	5

Table – D

Group II – 1% NaOCI (3% stock NaOCI solution diluted with 1% $NaHCO_3$)
pH – 10.5
Group IIA – Human dental pulp tissue

Sample No	Weight (grams)	Time of dissolution (min)	Amount of Solution Consumed (ml)
1.	0.3556	10	10
2.	0.2156	7	8
3.	0.3656	12	12
4.	0.4356	9	9
5.	0.6756	13	13
6.	0.5107	10	10
7.	0.4806	10	10
8.	0.6506	13	13

Table – E

Group III – 1% NaOCI (4-6% Stock NaOCI solution diluted with 1% $NaHCO_3$)
pH – 9.3
Group IIIA – Human dental pulp tissue

Sample No	Weight (grams)	Time of dissolution (min)	Amount of Solution Consumed (ml)
1.	0.5356	3	3
2.	0.4256	3	3
3.	0.4456	3	3
4.	0.4107	4	4
5.	0.4307	3	4
6.	0.8507	4	4
7.	0.5607	5	5
8.	0.3107	5	5

Table – F

Group IV – 1% NaOCI (4-6% Stock NaOCI solution diluted with double distilled water)
pH – 11.3
Group IVA – Human dental pulp tissue

Sample No	Weight (grams)	Time of dissolution (min)	Amount of Solution Consumed (ml)
1.	0.4956	2	2
2.	0.5007	4	4
3.	0.5806	2	2
4.	0.6506	2	3
5.	0.7206	3	3
6.	0.4307	2	2
7.	0.2506	2	2
8.	0.5106	2	2

Table – G

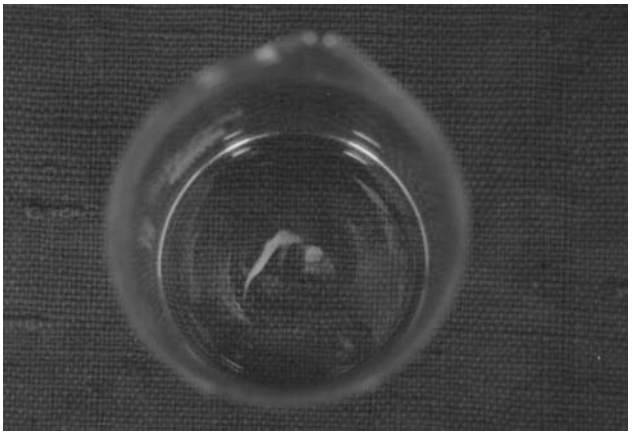
Group V – 1% NaOCI (3% Stock NaOCI solution diluted with double distilled water)
pH – 11.9
Group VA – Human dental pulp tissue

Sample No	Weight (grams)	Time of dissolution (min)	Amount of Solution Consumed (ml)
1.	0.5306	4	4
2.	0.6606	9	9
3.	0.6506	14	14
4.	0.5507	8	8
5.	0.6206	12	12
6.	0.1606	10	10
7.	0.1306	6	6
8.	0.4031	8	8

Table 1 Mean, standard deviation and test of significance of mean values between different pulp tissue Groups (IA to VA)

Variable	Group	Mean	S.D	P-value	Significant groups at 5% level
Weight (gm)	IA	0.3231	0.1427	0.17 (NS)	NIL
	IIA	0.4612	0.1540		
	IIIA	0.4963	0.1625		
	IVA	0.5175	0.1427		
	VA	0.4634	0.2128		
Time of dissolution (min)	IA	3.8	0.8	<0.0001 (sig)	IIA vs IA IIIA, IVA VA vs IA IIIA, IVA
	IIA	10.5	2.1		
	IIIA	3.8	0.9		
	IVA	2.4	0.7		
	VA	8.9	3.2		
Amount of solution consumed (ml)	IA	3.9	0.8	<0.0001 (sig)	IIA vs IA IIIA, IVA VA vs IA IIIA, IVA
	IIA	10.6	1.8		
	IIIA	3.9	0.8		
	IVA	2.5	0.8		
	VA	8.9	3.2		

Armamentarium



Human dental pulp tissue sample, kept for resolution

Inference

There is no significant difference in mean values of weight between groups IA to VA.

Time of dissolution and amount of solution consumed was significantly less for Group IA, IIIA and IVA as compared to Group IIA and VA.

Mean value of time of dissolution (min) in group IIA (10.5±2.1) is significantly higher than the mean value of time of dissolution (min) in groups IA (3.8±0.8) IIIA (3.8±0.9) and IVA (2.4±0.7) ($p<0.05$). Similarly, the mean value of time of dissolution (min) in group VA (8.9±3.2) is significantly higher than the mean value of time of dissolution (min) in groups I A, III A & IV A ($P<0.05$). However, no other contrasts are statistically significant ($p<0.05$).

The statistical software SPSS PC + (Statistical Package for Social Science, version 4.01) was used for statistical) analysis. Mean and standard deviation were estimated form the sample for each study group. Mean values were compared by student's independent t-test, Oneway ANOVA appropriately. Multiple range test byTurkey-HSD (Honestly Significant Different) procedure was employed to identify the significant groups, if p-value in one-way ANOVA is significant.

In the present study, $p <_ 0.05$ was considered as the level of significance.

Discussion

This study on tissue dissolving ability of five different sodium hypochlorite solutions is reproducible. 1% sodium hypochlorite prepared by diluting 4-6% stock NaOCI solution with the diluent 1% sodium bicarbonate solution dissolved group IIIA pulp specimens at the identical time and amount of solution required to dissolve group IA pulp specimens. However the pH value for group III was lower [9.3] than the pH value of group I [12.3]. Although 1% sodium hypochlorite solution prepared by diluting 4-6% stock sodium hypochlorite solution with double distilled water showed least time and volume to dissolve group IV A pulp specimens, it had a higher pH value [11.3] when compared to solutions used for group III [9.3] and lower pH value than solutions used for group I (12.3).

Within the limitations of the present study, it can be concluded that preparation of 1% sodium hypochlorite solutions diluting 4-6% stock solution with 1% sodium bicarbonate could make a biologically compatible irrigant. Dilution of 3% sodium hypochlorite solution either with double distilled water or with 1% sodium bicarbonate delayed the tissue dissolving with a statistical difference from the solution used for group I [undiluted 3% stock sodium hypochlorite solution could be avoided, instead it can be used as it is, since it has better tissue dissolving ability barring the high pH value.

It is important to mention about the dissolving method made in this study, Several past studies used fixed amount of dissolving solutions and arbitrary amount of tissues. Where as study made by Zehnder M, used known weight tissue samples by static dissolution was made. In this present study a dynamic method was made where known amount of irrigant kept for dissolution for known amount of time and aspirating and replenishing with fresh solutions, partially mimic the clinical situation. NaOCI rapidly disintegrates when it comes in contact with tissues and dissolving ability decreases. In routine irrigations, as solutions were aspirated and replenished, the tissue dissolving potential is maintained. Several past studies had used static dissolution, the solution were not aspirated and replenished. Whereas aspiration and replenishing made in this study mimics the clinical situation.

Further discussions are made based on the methodology used in this study. The samples, storage, precise weighing, the dissolving method, the solvent, their dilution and their pH values are discussed. The clinical implications with text and literatures are elaborated.

Although the original concentration suggested by Dakin was 0.5% the concentration used in dentistry was as high as 5.25% Spanberg in the successive editions of cohen quoted that sterile 1% NaHCO3 solution could be used as a diluent if one desires to make 1% NaOCI from commercial bleach. According to him this could adjust the pH to less caustic level. Studies by Zehnder et al (2002) and Spanberg have also suggested this. The base concentration, the diluent and the dilutions ought to have its implications on tissue dissolving ability, cytotoxicity, antibacterial activity and usefulness in clinical procedures.

Senia et al (1971) as quoted by Abou - Rass M (1981) had used pulp tissue of extracted teeth. A recent study by zehnder M (2002) had used the palatal mucosa of pig and estimated its weight. Similarly the weight of the tissues were determined in this present study. Zehnder et al quantified the tissues by size and weight with a tolerance of 5 mg and suggested that weight quantification in physical assay is better than the biochemical assay.

Studies on dissolution of dental pulp or pulp substitute tissues using stock or diluted solutions, assayed the pH value of NaOCI solutions and found to be in the range of 11.7 to 10.3 in Johnson BR (1993) and 12 to 9 in Zehnder et al (2002) studies. In this study all solutions were made using shortest possible stocks of stock solutions diluted for the required quantity for the given groups. This is to avoid any possible bias that could stem out of storage.

For successful endodontic treatment removal of pulp remnants, microbes and dentinal fillings from the root canal system is mandatory. Cleaning and shaping of apical portion of root canal is especially important as it is in close relationship with periradicular tissue. Irrigation is a "critical adjunct" in the canal system like narrow isthmi and apical delta's are cleaned only by the irrigants.

Alternate irrigation with H_2O_2 and NaOCI is a well known procedure in endodontics. However in the text Pathways of pulp, Cohen, as quoted by Grossman observed that NaOCI is the most effective irrigant for removing the loose debris. The combination of NaOCI with H_2O_2 seems to reduce the tissue dissolving ability of NaOCI. It is also known that Ca $(OH)_2$ potentiates the tissue solvent ability of NaOCI. This study analyzed the tissue solvent ability of NaOCI per se. Hence when the conclusions of the study carried to clinical practice the antagonistic and synergistic chemicals used along with NaOCI should be borne in mind.

Summary

This in vitro study evaluated the tissue dissolving ability of five different NaOCI test irrigant solutions. The four different solutions were made from two different stock solutions, 3% sodium hypochlorite (NaOCI) and 4-6% sodium hypochlorite (NaOCI), using two different dilutents, 1% sodium bicarbonate ($NaHCO_3$) Solution and double distilled water. The fifth one was 3% undiluted stock NaOCI solution as a control.

1ml spent solution, replenished with another 1m1 of solution, this process continued till the tissue dissolved totally.

The samples weight, amount of solution needed for dissolution, the time taken for dissolution subjected to statistical evaluation.

Within the limitations of the present study, it can be concluded that preparation of 1% sodium hypochlorite solutions diluting 4-6% stock solution with 1% sodium bicarbonate could make a biologically compatible irrigant. Dilution of 3% sodium hypochlorite solution either with double distilled water or with 1% sodium bicarbonate delayed the tissue dissolving with a statistical difference from the solution used for group I [undiluted 3% stock sodium hypochlorite solution]. Based on this tissue dissolution study, diluting 3% sodium hypochlorite solution could be avoided, instead it can be used as it is, since it has better tissue dissolving ability barring the high pH value.

Conclusion

1. Dilution of 4-6% stock sodium hypochlorite solutions with 1% sodium bicarbonate had the least pH value (9.3). Their dissolution potential was equal to undiluted 3% stock sodium hypochlorite solution (pH 12.3).
2. Dilution of 4-6% stock sodium hypochlorite with double distilled water showed least tissue dissolution time but the pH value was higher (11.3)
3. Dilution of 3% stock sodium hypochlorite solution with double distilled water or 1% sodium bicarbonate had lowered its tissue dissolution potential.
4. Further studies are required to study the clinical implications.
5. Dissolution studies could use the weight measurement schemes.
6. pH value assay of sodium hypochlorite irrigants could be a routine quality control in endodontics.

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