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Cover images depict the various treatment modalities and the research work being routinely carried out by all the departments at Terna Dental College & Hospital.

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EDITORIAL

Community dental health – Let's reach out

Community dental health aims at preventing oral disease and promoting oral health, thereby improving the overall quality of life through organised efforts of the society. As dental professionals, it is our duty to fulfil these objectives, and strive to make newer advances for achieving the same. A vast majority of the Indian population is concentrated in the villages, where most dental and medical health care facilities are inaccessible. Our primary endeavor should be to put into application the various techniques and treatments that we learn, and reach out to the underprivileged section of the masses, for affordable and sustainable dental care. The primary ideology must aim at adopting a preventive approach for reducing the incidence of dental diseases in the poorest fractions of the community.

This journal showcases various researches and studies conducted meticulously by the staff members of various departments of Terna Dental College. At the same time, it also provides a brief insight into the different diseases of the oral cavity plaguing the population in terms of their incidence, prevalence and distribution, factors governing them and the different treatment modalities for management of these diseases. Through this, we also aim at educating members of our fraternity about their role in improving public health and creating awareness about oral health diseases in the common folk.

To conclude, newer researches in the field of dentistry can help and should be developed to revolutionize the existing practices conducted for prevention and elimination of dental health problems in the regions that are deprived of basic health care facilities, and which are far from technology and modernisation.

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Premolarization of maxillary lateral incisor: A rare case of double dens invaginatus

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Abstract

Dens invaginatus (dens in dente) is a rare malformation with a widely varied morphology. Double dens invaginatus is an extremely rare dental anomaly involving two enamel lined invaginations presented in the crowns or roots of a tooth. An unusual presentation of a double dens invaginatus affecting permanent lateral incisor in a 32 year old female patient is reported. The etiology, pathophysiology, association with other dental anomalies, as well as the challenges in management of this anomaly are discussed. An extensive literature review is also presented. **(Terna J Dent Sci 2014;3(1):5-6)**

Key words: Double dens invaginatus, premolarization, maxillary lateral incisor.

Introduction

Dens invaginatus (dens in dente, dilated composite odontoma, gestant odontome) is a developmental anomaly resulting from invagination of enamel organ into the dental papilla, beginning at the crown and sometimes extending into the root before calcification occurs.[1,2] According to some investigators, the term 'dens in dente', originally applied to a severe invagination that gives the appearance of a tooth within a tooth, is a misnomer although it has continued in usage.[3] It can affect both primary and permanent teeth with a prevalence of 1.7-10%. Males are more affected with a ratio of 3:1.3,4 It occurs commonly in maxillary permanent lateral incisors followed by the maxillary central incisors, premolars, canines and less often in the molars. It usually occurs unilaterally although 43% cases occur bilaterally.[5]

Oehlers described this condition thoroughly in three classic articles which were published from 1957-1958 as: [6,7]

Type 1: an enamel-lined minor form occurs within the crown of the tooth and not extending beyond the cemento-enamel junction.

Type 2: an enamel-lined form which invades the root as a blind sac and may communicate with the dental pulp.

Type 3: a severe form which extends through the root and opens in the apical region without communicating with the pulp.

The latest classification in this regard was proposed by Schulze and Brand (1972),[8] which is more elaborate and illustrates a total of 12 different categories of this anomaly.

Double dens invaginatus is an extremely rare dental anomaly involving two enamel lined invaginations presented in the crowns or roots of a tooth. Very few cases of double dens invaginatus in a single tooth have been reported. According to Mupparapu9 only[9] cases of double dens invaginatus have been reported. This article reports a rare presentation of double dens invaginatus in a lateral incisor that has caused the tooth to appear like a premolar.

Case Report

A 32 year old woman reported for a routine dental treatment. The patient was in good general health. The maxillary right lateral permanent incisor was found to have an abnormal crown form (resembling a premolar). On the palatal surface, lingual cingulum was joined to the labial cusp by a prominent transverse ridge which divided the palatal surface into two fossae. Two palatal pits were located (Fig 1). On radiographic examination of the maxillary right lateral incisor, two dens invaginati were seen originating from each pit (Fig 2) confirming the diagnosis of double dens invaginatus. The maxillary left lateral showed a deep lingual pit and radiographic examination showed type I invagination. The tooth had a single root, was vital, and no evidence of periapical infection was noted. The two palatal pits were restored with composite resin restoration.

Conflict of interest and source of funding

The authors declare that there is no conflict of interest concerning the contents of the study.

This study has been self-supported by the authors.

Discussion

Dens invaginatus is rare and very often a surreptitious finding. The most significant concern of a dens invaginatus is the risk of developing pulpal pathology. Because of the lingual anatomy, it is possible for dental caries to easily reach the pulp chamber. Although enamel lines the coronal defect, it is frequently thin, often of poor quality, and even missing in some areas. The pit is often difficult to keep clean, and consequently, it offers conditions favorable for development of caries, usually leading to the necrosis of the adjacent pulpal and periapical tissues.[10] Hence radiographic examination is mandatory following clinical diagnosis.

If the radiographic appearance is unremarkable, pulp vitality testing should be carried out. If the results suggest vital and unaffected pulp tissue, then the tooth should be promptly restored. The clinician

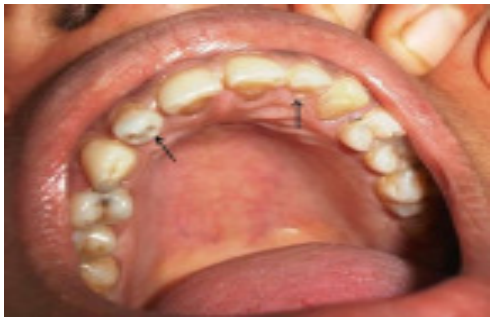

Fig 1: *Bilateral dens invaginatus w.r.t. 12 & 22 (arrows)*

Fig 2: *Radiographic appearance of 12 showing double dens invaginatus (A) & type I dens invaginatus w.r.t. 22 (B)*

should contemplate about this anamoly when presented with a case of pulpitis in the absence of history of trauma or clinical evidence of caries or restoration.

Various theories have been proposed over the years explaining the occurrence of dens invaginatus. The genetic and syndromic association has been debated upon without much clinical evidence. Mann et al considered the anomalies found in a patient to be a variant of Ekman-Westborg-Julian syndrome where multiple anomalies in dental morphology were found, including microdontia, microdontia, multituberculism, central cusps and pulp invagination.6 There are other reported sequelae of undiagnosed and untreated invaginated teeth like eruption delay, cysts and internal resorption.[6,7] A case of facial cellulitis secondary to dens invaginatus occurring in an unerupted maxillary lateral incisor has also been reported.[11] There are several reports of dens in dente associated with other abnormalities such as taurodontism, microdontia, gemination, supernumerary tooth and dentinogenesis imperfecta.[12,13,14] The case reported here had no other associated abnormalities.

The management of dens invaginatus with pulpal involvement varies from conventional endodontic treatment to special endodontic techniques capable of inducing an apexification. Pulpal involvement occurring at an early age requires apexification to facilitate apical closure before obturation.

According to Oehlers[7] description, the degree of invagination in our case was 'type 1' because invagination did not extend beyond the cemento-enamel junction. Both the teeth reported were vital and no evidence of periapical infection was noted. The invagination in 13 was so severe as to alter the shape of the tooth and make it appear like a premolar, hence the term "premolarized". In this case, the tooth was restored with composite resin restoration.

Conclusion

Based on this case, we suggest that it is very important for the clinician to be aware of this anomaly because of the high incidence of pulpal infection and degeneration associated with it. Multidisciplinary approach is warranted in some cases complicated by dens invaginatus. Prophylactic restoration as early as possible is recommended to avoid possible sequelae. Diagnosis of the condition, however mild, and timely treatment is the key to manage such cases.

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Banking Stem cells from Human Exfoliated Deciduous Teeth (SHED): Freeze them now to use later

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Key words: Stem cells, SHED, banking, cryopreservation.

Abstract

Stem Cells obtained traditionally were either embryonic in origin or from adult tissue which included both ethical concerns as well as invasive methods. Tooth derived cells are readily accessible and provide an easy and minimally invasive way to obtain and store stem cells for future use. Banking one's own tooth derived stem cells is a reasonable and simple alternative to harvesting stem cells from other tissues. Obtaining stem cells from human exfoliated deciduous teeth (SHED) is a simple and convenient procedure with little or no trauma. These teeth can be stored for treatment of future diseases by using regenerative procedures. In addition, these cells have minimum risk of rejection. Stem cells from younger teeth have better potential for regeneration.

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Introduction

Stem cells are defined as clonogenic unspecialized cells capable of both self-renewal for long periods and multi-lineage differentiation, contributing to regeneration of specific tissues. Stem cells can self-replicate and are able to differentiate into at least two different cell types. Both criteria must be present for a cell to be called as a 'stem cell'.[1] Discoveries in stem cell research present an opportunity for scientific evidence that stem cells hold great promise that goes far beyond regenerative medicine.

In 2000, the National Institute of Health mentioned the discovery of adult stem cells in the impacted third molars and even more resilient stem cells in the deciduous teeth. This indeed provides the prospect of regeneration of dentin and/or dental pulp. The biologically viable scaffolds can be used for replacement of the orofacial bone, cartilage and defective salivary glands, which can be partially or completely regenerated.[2]

Conflict of interest and source of funding

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Tooth banking is based on the firm belief that personalized medicine is the most promising avenue for treating challenging diseases and injuries that would occur throughout life. Individuals have different opportunities at different stages of their life for banking their valuable cells. Recent studies have shown that stem cells from human exfoliated deciduous teeth (SHED) have a greater ability to develop into various types of body tissues compared to other types of stem cells.

Stem cells from Human Exfoliated Deciduous teeth (SHED):

The documented discovery of SHED was given by Dr. Songtao Shi in 2003. SHED is an accessible and available source of stem cells that have been identified which can be easily preserved and used for future cure of ailments.[3] SHED are immature, unspecialized cells in the teeth that are able to grow into specialized cell types by a process known as "differentiation". SHED appear at the 6th week during the embryonic stage of human development. Scientists believe that these stem cells behave differently than post-natal (adult) stem cells. SHED cells multiply rapidly and grow much faster than adult stem cells. This suggests that SHED are less mature, so they have the potential to develop into a wider variety of tissue types.[4]

Abbas et al (2008) investigated the possible neural crest origin of SHED. They found that SHED are heterogeneous population that shares common molecular characteristics with neural crest cells and stem cells in vitro.[5] This ability to grow and regenerate tissues is the focus of the emerging field of personalized medicine which uses a patient's own stem cells for biologically compatible therapies.[4] Further, SHED are able to express proteins on their cell surfaces that allows them to not only differentiate into dental pulp, bone and dentin, but also into neural and fat cells (adipocytes).[5] In fact, SHED differentiate into nerve cells more readily than adult stem cells isolated from permanent teeth. SHED cells have been shown to express factors that induce bone formation and assist with the guidance of the eruption of the permanent teeth.[6]

Types of SHED:

- **Adipocytes:** Adipocytes have successfully been used to repair damage to the heart muscle caused by severe heart attack. There is also preliminary data to indicate they can

be used to treat cardiovascular disease, orthopedic conditions, congestive heart failure, Crohn's disease and to be used in plastic surgery.[7]

- **Chondrocytes and osteoblasts:** Chondrocytes and osteoblasts have successfully been used to grow bone and cartilage suitable for transplant.[6]

- **Mesenchymal:** Mesenchymal stem cells have successfully been used to repair spinal cord injury and to restore feeling and movement in paralyzed human patients. Since they can form neuronal clusters, mesenchymal stem cells also have the potential to treat neuronal degenerative disorders such as cerebral palsy, Alzheimer's and Parkinson's diseases. Mesenchymal stem cells have more therapeutic potential than other type of adult stem cells.[2]

Tooth Eligibility Criteria for SHED Banking:[4]

Each tooth holds unique regenerative potential. The teeth, especially primary incisors and canines with no pathology and having at least one third of root left, contain these unique types of cells in sufficient number. Primary teeth distal to the canine are generally not recommended for sampling. Primary molars have a broader root base and therefore, are retained in the mouth for a longer period of time than anterior teeth. Eruption of the posterior permanent teeth generally takes a longer amount of time to resorb the primary molar roots. This in due may result in an obliterated pulp chamber that contains no pulp, and thus, no stem cells. But In some instances, early removal of deciduous molars for orthodontic considerations may present an opportunity to recover these teeth for stem cell banking.

Advantages of SHED banking:

1. Provides an autologous transplant for life
2. Simple and painless procedure.[3]
3. SHED cells are complementary to stem cells from the cord blood.[6]
4. Useful for close relatives of the donor.[4]
5. Not subjected to the same ethical concerns as embryonic stem cells.[2]

Collection, Isolation and Preservation of SHED:

The technique is simple and non-invasive involving collection, isolation and storage of SHED.

Step 1: Tooth collection

First step is to place the tooth in sterile saline solution. The tooth exfoliated should have pulp red in color, which is indicative of cell viability. Teeth that become very mobile either through trauma or pathology, often have a severed blood supply and are not candidates for stem cell recovery. The tooth is then transferred into the vial containing a hypotonic phosphate buffered saline solution. The phosphate buffered saline solution provides nutrients and prevents the tissue from drying during transport. Up to four teeth can be carried in one vial. Placing a tooth into this vial at room temperature induces hypothermia. The vial is then carefully sealed and placed into the thermette; a temperature phase change carrier, after which the carrier is then placed into an insulated metal transport vessel. The time from harvesting to arrival at the processing storage facility should not exceed 40 hours.

Step 2: Stem cell isolation:[7,8]

When the tooth bank receives the vial, the following protocol is followed:

1. Tooth surface is cleaned by washing three times with Dulbecco's Phosphate Buffered Saline without Ca++ and Mg++ (PBSA).
2. Disinfection is done with a reagent such as povidine iodine and again washed with PBSA.
3. The pulp tissue is isolated from the pulp chamber with a sterile small forceps or dental excavator.
4. Contaminated pulp tissue is placed in a sterile petri dish which was washed at least thrice with PBSA.
5. The tissue is then digested with collagenase Type I and Dispase for 1 hour at 37ºC.
6. Isolated cells are passed through a 70 µm filter to obtain single cell supensions.
7. Then the cells are cultured in a Mesenchymal Stem Cell (MSC) medium which consists of alpha modified minimal essential medium with 2mM glutamine and supplemented with 15% fetal bovine serum (FBS), 0.1Mm L- ascorbic acid phosphate, 100U/ml penicillin and 100ug/ml streptomycin at 37ºC and 5% CO_2 in air. Usually isolated colonies are visible after 24 hours.

Step 3: Stem cell storage:

In the light of present research, either of the following two approaches are used for stem cell storage.

a. Cryopreservation
b. Magnetic freezing

a. Cryopreservation[9]

It is the process of preserving cells or whole tissues by cooling them to sub-zero temperatures.[4] At these freezing temperatures, biological activity is stopped, as are any cellular processes that lead to cell death.[11] Cells harvested near end of log phase growth are best for cryopreservation. The cells are preserved in liquid nitrogen vapor at a temperature of less than -150°C. This preserves the cells and maintains their potency. In a vial, 1-2 x 106 cells in 1.5 ml of freezing medium is optimum. Ice injury is a major concern for tissue cryopreservation. Kawasaki et al suggested that the slow and rate controlling freezing reduced the ice injury of cryopreserved living cells. Papaccio G et al (2006) studied the differentiation and morpho-functional properties of cells derived from stem cells after long-term cryopreservation to evaluate their potential for long term storage with a view to subsequent use in therapy. They concluded that dental pulp stem cells and their osteoblast derived cells can be long term cryopreserved and may prove beneficial for clinical applications.[10] The most serious problem during freezing is cell damage induced by ice crystal formation inside the cells as well as mechanical stresses by

extracellular ice formation. To prevent cell damage, vitrification can be utilised, that freezes cells quickly before ice crystals can form, which is an efficient approach used to cryopreserve oocytes and embryos.

b. Magnetic freezing:

It is the Cell Alive System (CAS). Under the condition of CAS magnetic field energy, water clusters do not accumulate but remain in smaller groups, thus minimizing restraining the expansion of the water. This technology is called CAS and uses the phenomena that applying even a weak magnetic field to water or cell tissue will lower the freezing point of that body by up to 6-7 degrees Celsius. Once the object is uniformly chilled, the magnetic field is turned off and the object snap freezes. The Hiroshima University company is the first expression of this new technology. Using CAS, Hiroshima University claims that it can increase the cell survival rate in teeth to as high as 83%. This compared to 63% for liquid nitrogen (-196 degrees C), 45% for ultra cold freezing (-80 degrees C), and just 21.5% for a household freezer (-20 degrees C). Maintaining a CAS system is a lot cheaper than cryogenics and also is more reliable.[11]

Commercial aspect of tooth banking:

These cells can be best utilized for the patients from which they are harvested, and to a certain extent their immediate family and blood relatives. As such, it is inevitable that the key to successful stem cell therapy lies in being able to harvest the cells at the right point of development. The stem cell can be safely stored until accident or disease requires their usage. Stem cells can be potentially stored for decades. The cost and technical difficulty of storage of stem cells makes stem cell therapy a still uncertain bet. Till date, tooth banking is not very popular but the trend is catching up mainly in the developed countries.

Licensed tooth stem cell banks, internationally and in India, used for cryopreservation and isolation are as follows:[12]

1. In Japan, the first tooth bank was established in Hiroshima University and the company was named as 'Three Brackets' (Suri Buraketto).
2. BioEden (Austin, Texas), StemSave, and Store a Tooth (USA).
3. The Norwegian tooth bank.
4. In India, Stemade Biotech Pvt. Ltd. (Delhi, Mumbai, Chennai, Chandigarh, Pune, and Hyderabad).

Conclusion:

Stem cell therapy is emerging as a revolutionary treatment modality to treat diseases and injury with wide ranging medical benefits. SHED are stem cells found in the exfoliated primary teeth of children. Recent studies show that SHED appear to have the ability to develop into more types of body tissue than other types of stem cells. This difference opens the door to more therapeutic applications. There is much research left to be conducted but the existing research has clearly shown that primary teeth are a better source for stem cells. While the promise of the immense scope and magnitude that stem cell therapies will have upon the population will only be fully realized in the future. Dental Professionals have realized that the critical time to act is now. The available opportunities to bank their patients' dental stem cells will have the greatest future impact if seized while patients are young and healthy.

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Childhood obesity and dental caries: Combating the cause

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Key words: Childhood obesity, dental caries, body mass index, paediatric dentist.

Abstract

Childhood obesity is a problem faced by many countries including developing countries like India. Developing countries like India are facing a double burden of disease. While the problem of malnutrition is still being tackled, there is an additional problem of obesity. The children suffering from obesity have an increased risk of developing adulthood obesity and medical conditions like cardiovascular diseases, diabetes mellitus and liver disorders. The major cause of obesity is the dietary pattern which includes increased consumption of refined carbohydrates, junk foods, soft drinks and lack of consumption of fruits and vegetables. These risk factors are also important factors in the etiology of dental caries. A paediatric dentist can play an important role in preventing childhood obesity and dental caries by providing dietary counseling to parents and children. This article highlights the role of a paediatric dentist in identifying childhood obesity, the cause of it and providing counseling to curb obesity and dental caries by modifying the risk factors.

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Introduction

Obesity and dental caries are the two foremost concerns for children in developing nations. According to statistics in 2012, more than 40 million children under the age of 5 years were overweight or obese. In developing countries with emerging economies the prevalence of childhood overweight and obesity in preschool children is in excess of 30%. Childhood obesity is associated with a higher chance of breathing difficulties, increased risk of fractures, hypertension, early markers of cardiovascular disease, psychological effects and obesity in adulthood. The etiology of obesity is multifactorial, although one of the principal factors is dietary habits with consumption of food with high sucrose content, increased frequency of snacking, consumption of aerated beverages, reduced intake of fibrous fruits and vegetables.[1] Since pathogenesis of both obesity and dental caries has been found to be associated, it has been suggested that both diseases may share the same etiologic factors.

As the obesity epidemic escalates, paediatric dentists can play a major role in modifying the diet at the earliest by providing diet counselling and anticipatory guidance to the parents. This article discusses the role of a paediatric dentist in combating the two major childhood diseases: obesity and dental caries.

Relation between childhood obesity and dental caries

Obesity is a complex disorder involving an excessive amount of body fat. High prevalence is being increasingly reported in children from developing countries as well. According to recent

Indian data, prevalence of overweight among 14-17 year old urban children in 2006-2007 was 29% in private schools and 11.3% in government-funded schools in New Delhi.[2] The combination of genetic propensity in Indians to store fat, the ready availability of calorie dense foods and sedentary lifestyle promotes overweight.Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer and osteoarthritis.[3] Childhood obesity and dental caries epidemics are multifactorial complex disease and children's dietary pattern is a common underlying etiologic factor in their causation. The diet with high and frequent carbohydrates consumption especially between meals

increase the risk of nutritional diseases and dental decay. Apart from the common etiological factor, there is also an increased prevalence of dental caries and other dental diseases in obese and overweight children. Tuomi was one of the first to consider the relationship between caries and obesity, finding that in a group of 515 Finnish school children, the combination of obesity and previous caries experience was a strong predictor of caries in permanent molars.[4] In India too, a low BMI showed a correlation with the absence of carious lesions and a high BMI was linked to a high number of carious lesions.[5,6] However, it cannot be concluded that "obesity increases risk of caries" or "caries increases the risk of obesity" since most of the studies focus on the quantitative aspect of food and not the qualitative aspect. Rather, it is

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more realistic that a common risk factor increases the likelihood of both diseases, which are then observed in association.[7]

Role of a Paediatric dentist in combating obesity and dental caries

As described earlier, childhood obesity and dental caries share common risk factors. Hence, a paediatric dentist can play a significant role in prevention of both these diseases. The role of a paediatric dentist begins with general assessment of the child to determine if the child is overweight or obese. This should be carried out during the first dental visit.

BMI is a measure used to determine childhood overweight and obesity. It is calculated using a child's weight and height. BMI does not measure body fat directly, but it is a reasonable indicator of body fatness for most children and teens. A child's weight status is determined using an age- and sex-specific percentile for BMI rather than the BMI categories used for adults because children's body composition varies as they age and varies between boys and girls.

CDC Growth Charts are used to determine the corresponding BMI-for-age and sex percentile. For children and adolescents (aged 2—19 years):

- Overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile for children of the same age and sex.[8]
- Obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex.[8]

Once the BMI percentile is assessed, the next step is collecting information about whether the patient eats regular meals, the frequency of snacking, the types of snacks and beverage consumption. This can give a quick and easy clue for increased disease risk. It may also be helpful to recognise the patient's socio-economic status, lifestyle, cultural beliefs and personal dietary choices. After oral examination, while addressing the dental problems of the child, the paediatric dentist should provide the parents and patients with preventive guidelines that will aid in curbing obesity as well as dental caries. A diet chart with guidelines regarding the amount of servings of different foods will be beneficial for the patient. Appropriate referrals should be done if the practitioner suspects any medical problems secondary to obesity. As members of the dental health team, it is critical that paediatric dentists maintain awareness of this obesity problem and participate in the assessment and prevention of childhood obesity.

Discussion

Childhood obesity and dental caries to a great extent are preventable diseases. Overweight and obesity among most world populations have risen during the last two decades and this change appears to be driven by factors that are unlikely to recede. The rise in childhood obesity is one of the gravest problems of the future. This trend may adversely affect the prevalence of dental disease in the future. Despite many alarming findings, health professionals in both medicine and dentistry have been slow to implement clinical protocols to aid in the prevention, diagnosis and treatment of childhood overweight and obesity.[9] Dental professionals and those in training today must become aware of this growing problem, of the demands that this will place on dental care services and the need for the training of special care dentists.[10] Together, with service providers, paediatric dentists must prepare themselves for the challenge ahead.

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Hydrophotonics: A new purview in laser dentistry

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Abstract

The old concept "extension for prevention" is changed to "prevention of extension". It is important to be open to new technology, by being more creative in terms of developing new techniques or modifying and improving the existing ones. The Waterlase™ is a revolutionary tool for dentists which is a unique combination of laser energy and water, a process called Hydro Photonics™. Waterlase laser cuts hard and soft tissue without heat, vibration or pressure; so that the dentist may be able to perform the procedure without anesthesia. Also, the Waterlase laser reduces bleeding, post-operative pain, swelling and the need for analgesics in many cases. It is extremely versatile and can be used for a wide range of hard and soft tissue procedures.

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Key words: Waterlase, Hydrophotonics, Er. Cr: YSGG Laser.

Introduction

The advent of lasers along with the trend towards prevention and preservation shifts dentistry away from previous familiar conventional methods.[1] The name laser is an acronym for Light Amplification by the Stimulated Emission of Radiation. It has been used in dentistry since 1990. It is an instrument that produces a very narrow, intense beam of light energy. This when in contact with tissue causes a reaction leading to removal or shaping of tissue. Being used with other dental instruments, they can be used as safe and effective treatment for a wide range of procedures.

The lasers available in dentistry are mainly Ruby, Nd:YAG, CO_2, Ho:YAG, Er:YAG, Nd:YAP, Argon, Diode.[2] These lasers were mainly applied to soft tissue procedures. The effects of argon, Nd:YAG and CO_2 lasers on caries removal were also investigated.[3-5] However, these lasers caused major thermal side effects such as melting, cracking of enamel and dentin and pulpal damage.[6-10] The waterlase laser (Biolase), one of the modifications of lasers has wide clinical applications in dental hard tissue treatments such as caries removal and cavity preparation.[11] It also has wide range of applications in intraoral soft tissue procedures. Therefore, it allows the dentist to reduce the anesthetic need, diminishing the patient anxiety and providing a relaxing dental experience. This allows the dentist to cut teeth, bone and gingival tissue with less trauma.

Waterlase laser was approved for use by FDA in 1998.[1] It requires 88 pounds per square inch air pressure provided by an external source.[12] It involves the use of a laser using argon of a specific wavelength taking care of many dental problems that require a handpiece. Due to less need for anesthesia and less postoperative numbness, waterlase lasers have far reaching benefits.

Principle of hydrophotonics

Waterlase lasers uses a patented technology combining erbium:yttrium scandium, gallium and garnet (Er:YSGG) laser energy and a spray of water, a process called Hydrophotonics. The waterlase laser in particular cuts biocalcified tissues effectively through the use of hydrokinetic system delivering photons into an air-water matrix system. The laser energy absorbed by this water matrix partially facilitates the cutting effect.[12]

While cutting hard tissue, no physical contact is made with the tissue. The laser energy is transferred to the water, which is then transferred to the tooth vaporizing the tissue. The powered hydrokinetic system produces a wavelength absorbed maximally in water molecules and targets the hydroxyl groups of enamel and dentin.[13] Thus; in hard tissue applications; the spray is a part of tissue removal process as well as hydration, cooling and keeping the tissue clean. A rough surface is created with cuts resulting in no smear layer formation enhancing bonding and shear strengths.[14] Hydrokinetic energy produced by combining a spray of atomized water with laser energy also gently and precisely removes a wide range of soft tissue with no heat and no pain in most cases. For the soft tissue procedures, the laser itself does the cutting with the water stream acting as a coolant. A visible light emitted from the hand piece distal end pinpoints the area of treatment. The laser hand

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piece resembles a high-speed hand piece but it has fiber optic tips instead of burs. These tips direct the laser energy at a focal point of approximately 1 to 2 mm from tissue surface.

In both hard and soft tissue applications; the power output, the pulse energy, repetition rate, air and water flow rates are adjustable to specific user requirements. Laser powered hydrokinetic system uses an Er, Cr: YSGG crystal with a photon emission wavelength of 2.78 micrometers (Hadley et al, 2000).[2]

Advantages of Hydrophotonics

1. **Virtually painless**
   Heat, vibration and pressure are the primary causes of pain associated with the use of the traditional dental handpiece. Since the cutting of both hard and soft tissues with the Waterlase laser does not generate heat, vibration or pressure, many dental procedures can be performed nearly pain-free with fewer shots, less need for anesthesia.[2,15]

2. **Accurate and precise**
   It removes the tooth enamel decay, bone and gingiva precisely while leaving surrounding areas unaffected.[2,15]

3. **Reduced trauma**
   There is reduced damage to healthy portions of the tooth and trauma is minimized.[2,15]

4. **Reduced bleeding and swelling**
   It performs many intraoral soft tissue procedures with little or no bleeding and less post-operative swelling due to its conservative cutting action.[16]

5. **Fewer dental visits**
   Since the need for anesthesia is reduced, cavity preparations can be simultaneously performed in all areas of the mouth in a single visit.[2,15]

6. **Extremely versatile**
   Wide range of hard and soft tissue procedures can be performed with Waterlase lasers.[15]

Disadvantages of Hydrophotonics

1. **Expensive**
   Waterlase laser is quite expensive so it may not be used in smaller dental practices.

2. **Technique sensitive**
   Special training is required before using this laser.

3. **Contraindicated in some systemic condititons**
   Use of Waterlase lasers is contraindicated for certain medical conditions like heart disease, lung disease or an immune system deficiency.

Clinical uses of Hydrophotonics

1. **Hard Tissue Applications**
   - Class I, II, III, IV and V cavity preparation
   - Caries removal
   - Hard tissue surface roughening or etching
   - Enameloplasty
   - Excavation of pits and fissures for placement of sealants
   - Bone surgical procedures (Alveoloplasty, Osteotomy)

2. **Soft Tissue Applications**
   - Excisional and incisional biopsies
   - Exposure of unerupted teeth
   - Removal of fibroma
   - Frenectomy and frenotomy
   - Gingival surgeries
   - Hemostasis
   - Implant recovery
   - Incision and drainage of abscesses
   - Laser soft tissue curettage of the post-extraction tooth sockets
   - Leukoplakia
   - Operculectomy
   - Oral papillectomies
   - Removal of pathological tissues (i.e., cysts, neoplasm or granulation tissue)
   - Soft tissue crown lengthening
   - Treatment of canker sores, herpetic and aphthous ulcers of the oral mucosa
   - Vestibuloplasty

3. **Laser endodontics**
   - Laser root canal disinfection after endodontic treatment
   - Tooth preparation to obtain access to root canal
   - Root canal debridement and cleaning
   - Cutting bone to prepare a window access to the apex of the roots in apicocetomy
   - Root end preparation for retrofill amalgam or composite
   - Pulpotomy

4. **Laser periodontal therapy**
   - Waterlase laser assisted new attachment procedure (cementum-mediated periodontal ligament new attachment to the root surface in the absence of long junctional epithelium).
   - Flap surgeries (Full thickness, partial thickness, split thickness)
   - Laser soft tissue curettage
   - Removal of highly inflamed edematous tissue affected by bacteria penetration of the pocket lining and junctional epithelium
   - Removal of granulation tissue from bony defects
   - Sulcular debridement (removal of diseased or inflamed soft tissue in the periodontal pocket to improve clinical indices including gingival index, gingival bleeding index, probe depth, attachment loss and tooth mobility)
   - Removal of subgingival calculi in periodontal pockets with periodontitis by closed or open curettage.[14-17]

Conclusion

The waterlase laser has efficiently proven to be safe and effective in the cutting of enamel, dentin, cementum, bone and gingival tissue. It shows promise for cavity preparation in the future and is on a path to replace conventional handpiece usage amongst dental professionals. The paediatric population will especially benefit from the advent of a hard tissue cutting laser. Properties such as maximal comfort will provide greater range of compliance amongst the younger age groups increasing efficiency and satisfaction in treatment. The wave of the future in the new millennium of dentistry follows the idea of preservation, prevention and maximum patient comfort levels. Waterlase laser also presents as the first system to be clinically significant in the utility of hard tissue surgery.[18]

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Rehabilitation of a case of Down's syndrome-A clinical report

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Keywords: Down's syndrome, overdenture, characterised denture.

Abstract

The complete rehabilitation of patients with Down's syndrome coupled with their psychomotor and cognitive disabilities requires a comprehensive and interdisciplinary approach. Normal social and psychological development of such medically challenged patients have to be treated in such a manner that they look and feel as normal as possible.

Treating patients with downs syndrome requires the clinician to be knowledgeable in growth and development, behavioural management and special treatment protocols in fabrication of prosthesis best suited for the patient. The ability to motivate the patient to undergo this treatment and to have their cooperation during the treatment is a skill. Also to make the parents understand the use and maintenance the prosthesis is definitely a pathway for successful rehabilitation of such patients. This paper is a case report of a 22 year old female patient with Down's syndrome who pertains to Prosthodontic rehabilitation with an overdenture as a preferred treatment modality.

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Introduction

Children with special health care needs are those, whose psychological development, social expression, play or work is compromised due to a physical or mental problem or both. However, their feelings match exactly with the other children; and all they need is understanding, patience and respect. Positive support can help them lead an independent and financially stable life. Community lacks the awareness of dealing with such children. In our country, especially in rural areas the orthodox and religious beliefs often lead to negligence of such children. The incidence of such children is about 0.12% in the total country's population (US census bureau 2004). Also, these children lead lesser lives because of multiple systemic problems. The challenge lies in providing adequate facilities for education, training and rehabilitating of these special children.

Down's syndrome, also known as trisomy 21 and mongolism, was first described by John Langdon Down.[1] It is a genetic condition caused by an extra chromosome 21 which results in various systemic and oral anomalies as well as learning disabilities and a characteristic appearance.

Conflict of interest and source of funding

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Dental features associated with Down's syndrome include: open mouth posture due to underdevelopment of the middle third of the face, poor muscle tone, macroglossia, delayed development and eruption of the teeth, hypodontia, microdontia, hypocalcification and hypoplastic defects and high incidence of severe periodontal disease. The increased frequency of periodontitis is in a large part to poor oral hygiene and an exaggerated immune-inflammatory response of the oral tissues. Therefore, the most common dental problem faced by these patients, is numerous carious teeth due to poor oral hygiene. And tooth mobility due to periodontitis leaving no choice but extraction. The management of missing teeth in Down's syndrome patients poses a challenge due to the presence of macroglossia, a tendency towards poor co-operation and the inability to adapt to complete dental prostheses due to motor and mental deficiencies.[2] The replacement of missing teeth by retaining teeth with good prognosis may overcome some of these problems and provide patients with a stable prosthesis.

Since there is no preventive or interceptive treatment for Down's syndrome, all that can be done is to improve the patient's appearance, mastication and function. This report focuses on the treatment challenges associated with Down's syndrome. Removable prosthesis is the most frequent treatment modality used for dental management of downs syndrome. Although complete dentures are an acceptable form of treatment, overdenture or RPD supported by natural teeth are desirable for preservation of alveolar bone.

The advantages of preserving the natural teeth are, (i) Preservation of alveolar bone, (ii) Preservation of proprioception, (iii) Improved retention (iv) Improved support, and above all (v) Less psychological trauma of losing natural teeth for patients.[3] The principal aim is to restore missing teeth to establish normal vertical dimension and to provide support for the facial soft tissues, thereby providing the patient with optimal esthetics and function which would raise patient's self-confidence and improve quality of life. Realistic tooth arrangement, gum imitation: especially

with features such as muscle attachments, root details and colouring of the denture can be done to provide the patient with 'true-to life' prosthesis.

Case Report

A 22 year old female patient who had been diagnosed with Down's syndrome and otherwise healthy was referred to the Dept. of Prosthodontics, Terna Dental College, Navi Mumbai. Her chief complaint was pain in teeth and few missing teeth. Interaction with her showed that patient had moderate mental retardation but was able to understand and communicate to an acceptable level. She attended the special school till the age of 18 yrs. She was independent in her routine activities, hygienic and brushed her teeth once a day. She gave a history of visit to a private dental practitioner where treatment consisted of extractions and occasional scaling and fillings (Fig. 1).

On examination, her oral hygiene was poor with numerous carious teeth, generalized plaque accumulation as well as supra and sub-gingival deposits of calculus. Radiographic interpretation presented generalized horizontal bone loss of half to two third root length. Overetained deciduous teeth were seen with mandibular lower central incisors. Carious teeth were seen with 11 12 14 15 16 17 21 24 25 26 27 34 36 44. 36 and 46 were congenitally missing (Fig. 2).

A comprehensive treatment plan was prepared and discussed with her caretaker. It was agreed that 11 12 14 15 16 17 21 24 25 26 27 34 36 44 would be extracted. It was planned to retain 13 22 23 32 33 42 43 45. Options for the replacement of missing teeth such 'implant-supported fixed/ removable maxillary and mandibular prostheses were also discussed. It was decided that the patient would receive removable maxillary and mandibular complete prostheses retaining natural teeth as abutments.

Extractions were carried out without any complications. Endodontic treatment was done with 13 22 23 32 33 42 43 and 45. These teeth were reduced to gingival level to receive overdenture, amalgam was plugged in and polished (Fig. 3). Oral hygiene instructions were provided to both the patient and her caretaker.

Impressions were made by conventional technique. Primary Impressions were made using irreversible hydrocolloid impression material (Tropicalgin, Zhermack). Custom tray was fabricated. Border moulding was done using low fusing compound (DPI pinnacle tracing sticks, Dental Products of India) and final impressions were made in A-silicone light body impression material (Aquasil, densply). Master casts were obtained in type 3 dental stone (Kalabhai, Mumbai, India). Casts were mounted on semi adjustable articulators (Hanau Wide Vue) using a facebow (Hanau Spring bow, Whipmix USA) and centric bite record was made. The teeth arrangement was done in centric relation, occlusion was adjusted slightly, For anteriors, in order to improve facial characteristics and smile of the patient, the dentures were characterized. The denture bases were characterized to depict natural stippling, pigmentation and the root contours (Fig.4, 5).

It was made sure that the denture borders were thinned as presence of macroglossia hinders stability of the denture. The overdentures were processed in conventional manner. The dentures were inserted with minor adjustments and the occlusion was checked intraorally. Intaglio

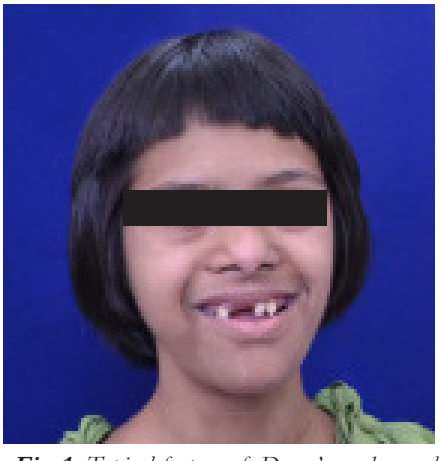

Fig 1: *Typical feature of Down's syndrome: brachycephaly, widely spaced eyes, smaller maxillary bone, Class III profile*

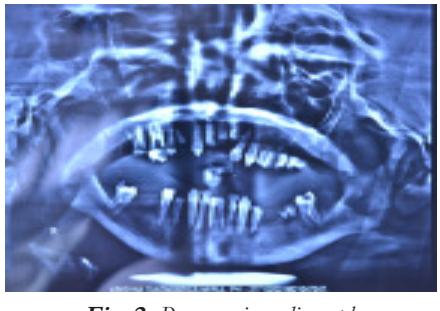

Fig 2: *Panoramic radiograph*

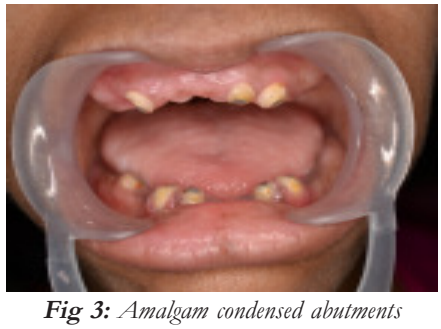

Fig 3: *Amalgam condensed abutments*

Fig 4: *Intaglio surface of polished dentures*

Fig 5: *Characterised dentures*

Fig 6: *Functionally and psychologically satisfied patient with characterized overdenture*

surface of overdenture was checked for any irregularities (Fig. 4). Written oral hygiene instructions were given to the care taker and demonstrated to the patient. Attractive denture box, tooth brush and denture cleaning tooth brush were provided to the patient to encourage oral and denture hygiene. Frequent use of fluoride rich mouth rinses was advocated. Patient was highly satisfied with the denture appearance and function. Patient was recalled after 24 hours and 1 week. The patient was asked to follow-up after every 3 months regularly for fluoride application and denture recall schedule.

Discussion

The severity of oral diseases in patients with Down's syndrome together with their psychomotor and cognitive disabilities requires a comprehensive treatment plan including the overall management of each individual's oral hygiene programme. This management program depends on the patient's ability to cooperate during treatment as well as the maintenance of an optimal oral hygiene practice.

However complete dentures are contraindicated for patients who lack adequate muscle control or cognitive skills to fully adapt to the prosthesis. A study of patients with different disabilities, including mental retardation, illustrated how tooth and implant-supported prostheses produced relatively good results. It contributed to improved aesthetics and oral function of the patient.[4] Implant treatment option may not be possible in Down's syndrome cases as these patients develop osteoporotic bone.

Neil's Bril (1955) classified the dentures that made use of existing natural teeth and therefore had characteristics of both removable partial denture and a complete denture, which he termed it as "Hybrid Prosthesis". Problems like loose dentures, loss of proprioception, bone resorption can be resolved with overdentures & it is the last line for patients from becoming edentulous.

In the present case, we decided to retain natural teeth which could be treated endodontically and use them as abutments for overdenture for complete denture. Most patients with mental or physical disabilities may require conscious sedation or even general anaesthesia for the surgery to be undertaken. In this case however, the patient proved to be cooperative during the exodontia procedure as well as during endodontic treatment. This was achieved through verbal communicative efforts throughout her treatment. Also, Down's syndrome patients are called 'smiling saints' they are considered to be the most co-operative patients among mentally challenged children. However the treatment was carried out, keeping early and short duration appointments to achieve best patient's cooperation.

The main objectives of fitting prostheses in patients with Down's syndrome are to improve the esthetics, phonetics, and masticatory function. Prostheses may also improve the tone of the muscles of mastication and compensate for the reduced vertical dimension. A conventional overdenture was the treatment of choice for this patient, because the objectives were to preserve the remaining dentition, to restore function, and esthetics. More over the patient also insisted to preserve her natural teeth. Patients treated with complete maxillary overdenture and mandibular overdenture demonstrates less vertical alveolar bone loss than patients with conventional complete maxillary and mandibular dentures. Ten years of clinical investigation show that weak teeth used as support for denture prosthesis not only remain in position but also a number of them have regained a healthier status.

The primary aim was to have an entire dental composition complimentary to the face and to itself. At the same time care was taken that, teeth arrangement was not mechanically straight or without uniqueness. Proportion and the dominance were decided as per the patient's personality. A mold which expresses a softer anatomic characteristics or which is highly adaptable to being shaped into delicate form is chosen. Balance was obtained between the colour of the teeth and the denture base to match with patient's complexion. An illusion of natural teeth and esthetics in artificial dentures was created. It was based on the elementary factor influenced by sex, personality and age of the patient.[5] The article torches the scientific approach to the artistic nature of overdenture construction to prosthetic treatment of Down's syndrome.

Conclusion

Prosthodontic therapy with complete overdenture prosthesis helped in developing proper speech, deglutition and mastication. Characterization of denture improved esthetics and had dramatic social and psychological benefits for this patient. The overall facial composition made the patient highly satisfied. An immediate recall of 24 hrs and 7 days was scheduled. Patient was regular with her recalls visits. Patient was asked to grow her hair and maintain them to have a grown up look (Fig. 6). A recall of 3 months and 6 months showed better co-operation of the patient. The dentures were well maintained and good oral hygiene was noted. Retained teeth with good oral hygiene can successfully be used to support over dentures in Down's syndrome patients so as to increase retention, stability and support of the prosthesis.

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Perception towards the subject of Public Health Dentistry among students of Terna Dental College, Navi Mumbai: A questionnaire study

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Abstract

Aim: To evaluate the perception of dental students towards the subject of Public Health Dentistry.

Material and methods: The study involved 90 final year dental students and 96 interns in Terna Dental College, Navi Mumbai. Questionnaire included 17 questions on perception towards the subject of Public Health Dentistry. Responses were recorded on Likert's scale. **Results**: According to the quantitative results, there was no significant difference between the scores of students from both the groups in terms of their statements regarding the subject of dental public health. Both students and interns recognized the importance and contribution of public health dentistry in their future professional life. Study revealed that there was lack of willingness to work in rural sector as well as motivation for preventive oral health care. **Conclusion**: Continued motivation and reinforcement of students towards dental public health should be given to reach the goal of oral health for all.

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Key words: Perception, dental public health, preventive care.

Introduction

Public health refers to all organized measures (whether public or private) to prevent disease, promote health and prolong life among the population as a whole. Its activities aim to provide conditions in which people can be healthy and focus on entire population, not on individual patients or diseases. Public health is concerned with the total system and not only the eradication of a particular disease. Public health professionals monitor and diagnose the health concerns of entire communities and promote healthy practices and behaviours to ensure that populations stay healthy.[1]

Public health applications require an inter-professional team of health care providers. It is required that all work forces which serve the community should be trained and made aware of their responsibilities.[2,3] Dental public health includes preventive care against dental diseases. Dentists are expected to know the importance of preventive care and health promotion, to be aware of the relationship between oral and dental health and general health and to present preventive care appropriate to the community.[4] It has been stated that universities have an important role to play in enabling dentists to become culturally sensitive and public health oriented practitioners.[5,6] On the other hand, it was also stated that health care professionals did not volunteer in preventive care in under graduate education and it was not sufficiently emphasized in curricula.[7]

The purpose of this study was to evaluate the perception of dental students and dental interns towards dental public health subject.

Conflict of interest and source of funding
The authors declare that there is no conflict of interest concerning the contents of the study.
This study has been self-supported by the authors.

Material and methods

A cross-sectional questionnaire study was conducted among the final year dental students and interns in Terna Dental College, Navi Mumbai, India in January 2015. The ethical clearance was obtained from institutional review board and an informed consent was taken from the study participants. The study included 90 final year students and 96 interns.

A questionnaire was constructed to collect the information using questions from a similar study conducted by Mandiracioglu A and Dogan F in 2012.[8] This questionnaire proforma was pilot tested and validated among 30 participants. These subjects were not included in the final analysis. With the census sampling, all the students and interns who were present on the day of study were included in the study. The questionnaire proforma consisted of two parts. The first part consisted of general information like age, gender and year of study. Second part included 17 questions related to the perception and attitude towards the subject of Public Health Dentistry. The attitude questions were ranked on 3 point Likert scale – agree, uncertain and disagree. Proforma was distributed to final year students in lecture

hall and collected back in 15 minutes. Interns were given proforma in their respective department of posting.

The data was analyzed using Statistical Package for Social Science (SPSS 17.0). The *p*-value was taken as significant when less than 0.05 (Confidence interval of 95%). Descriptive statistics was carried out to calculate responses for each question. Z test was used to compare the responses among the two groups.

Results

The response rate was 100% in the present study as all the final year students and interns completed the study. Overall the mean age of participants was 23.29±1.3 years. Gender distribution showed more number of females compared to males. In the final year, 28.8% were males and 71.2% were females whereas among interns 16.7% were males and 83.3% were female participants (Graph 1).

Overall, 51% of the participants responded to having an intention to work in the rural area for a period of their professional life (Graph 2). There was a significant difference among the two groups where more number of final year students (64.4%) opted for this compared to interns (42.7%), ($p < 0.05$) (Graph 5).

For their professional career plan (Graph 3), around 33% of the participants stated that they wanted to establish their own clinic. Overall 17% selected for specialization and then exercising their profession outside the country. In this study, merely 12.9% of the participants were willing to work in public sector and significantly more number of final years (18.6%) chose this compared to interns (9.4%), ($p<0.05$) (Graph 5).

When we asked the reason for choosing dentistry as a profession, 37.4% of the study participants reported to have a special interest in this field. The proportion of final year students was significantly more compared to interns, ($p<0.05$). Whereas, 16.8% took dentistry on parental advise and 22.6% gave no particular reason to choose this field.

The responses of the students for the statements on dental public health education are presented in Table 1. Almost 92% of the participants were in agreement that they are member of the team that offers oral health services and 87.7% stated that they have chosen an important profession for the oral health of the community. 85.8% said that they learned, preventive care aimed at reducing oral diseases and injuries in the community and it has taught them ways to protect against oral diseases. 83.9% agreed that it has helped to understand the oral health levels of the community. 85.2% agreed that this subject has shown the primary oral health problems of the community. 81.9% agreed that this subject will be helpful in their professional life and almost 80% agreed that they learned in this subject that holistic approach is required in oral health and oral health education. There was no significant difference in the views of final year and interns. Overall 74.2% agreed that this subject has contributed in gaining critical thinking and problem solving skills. Significantly more number of final year students (81.4%) agreed for this compared to interns (69.8%), ($p<0.05$). 86.5% agreed that this subject has taught them that while treating oral diseases, many factors such as the social and economic conditions of the individual should be taken into consideration. Significantly more number of interns (90.6%) agreed with this compared to final year students n (79.7%), ($p<0.05$).

The responses of the students for preventive care are presented in Table 2. Overall almost 40% said that they are more interested in treatment services than preventive care. Around 90% agreed that preventive care is primary for the oral health of community and it is their professional responsibility to prevent oral diseases. 89% agreed that preventive care will have an important place in their professional life. There was no significant difference in the views of final year students and interns.

Discussion

Public Health Dentistry is a branch of specialization in dentistry which focuses on the overall oral health of the community. The branch deals with preventive and curative services for individual patients and also promotion of better oral health for community at large. This branch shows a different role of dental professionals in society as a provider of comprehensive oral care to the public. Uneven distribution of oral health care facilities especially in rural areas, lack of awareness regarding oral health and hygiene are bound to make public health dentistry an important discipline.[8] The present study was conducted to assess the perception of dental students towards the subject of Public Health Dentistry in Terna Dental College, Navi Mumbai.

In the present study, almost 80% were female participants. The expansion of the number of women in dentistry has been one of the major dental workforce trends during the last quarter of the past century and will continue during the initial decades of this century. This is reflected in the greater number of female than male applicants to dental schools. Since 1999 there has been an increase in the female students, more so in 2000, and this trend is continuing today.[9]

Present study revealed that most of the students had a positive view on the subject of Public Health Dentistry and they were aware of the fact that this subject was an important opportunity for reaching and helping the community. This is in accordance with the other studies[10,11]

In literature, it has been noted that knowledge alone is not sufficient for the achievement of preventive oral health services, it is also essential that oral health care professionals should be positively oriented toward the prevention.[11] In the present study, although 90% of the students agreed that preventive care is primary for the oral health of community and they have professional responsibility to prevent oral diseases, only 40% of them were more interested in treatment services. This difference could be due to the financial benefits associated with treatment services rather preventive services.

Numerous challenges exist for expanding oral health care in India. At the moment India has one dentist for 10,271 persons. Most dentists prefer to practise in urban areas with high standards of living; hence, with 70% of the dentists practising in the cities, only 30% are providing care for the semi-urban and rural population.[12] It is often difficult for the poor urban and the rural population to get access to emergency care. Community-oriented oral health programs are seldom found.[9] Findings of this study also show that merely 9% of the students were willing to work in rural areas which raises a big question on the attitude towards the dental public health that our students are developing during their dental education. Complete stagnation with regards to the infrastructure and the basic facilities provided in rural areas are probable reasons for reluctance to work in rural areas.

When students were asked about their professional career plan, almost 17% of the students wanted to practice their profession outside the country. This can be attributed to the monetary benefits that the dentists get in most of the developed countries. Lack of adequate research facilities is also one of the reasons for a small percentage of immigration.[13] The facilities in the developed countries are more advanced, easily accessible, and more promising compared to those available in India. Those aspiring to rise in research and academics prefer to go abroad.[9]

Dentists are an important part of the health service team and they have an important role in the preventive services. It is important that policy makers and institutions embrace more fully the roles of dentists and other health care professionals in dental public health and preventive care. They should develop health policies which ensure that all health care professionals undertake roles in preventive care in developing countries where the sources are limited.[14] The world is changing at enormous speed. The workforce should be able to keep pace with the fast changing society so that it is not left behind in its service and is able to cope with the desires of the society.[15] The goal of the workforce should be based on a commitment to prevention. Health education and the development of an effective health care system with proper communication are a must.

Conclusion

This study once again underlines the importance of dental public health subject. Students seem to agree on the necessity and the importance of this subject in curricula. They mentioned the contribution of dental public health subject in their professional career. The lack of willingness in providing preventive care and working in rural areas are the major concerns. Continued motivation and reinforcement of students towards dental public health should be given to reach the goal of oral health for all. There is a need to conduct further studies to explore this area involving various dental colleges across the country to have more generalised results.

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Table 1: The distribution of the students who stated that they agreed with the related statements (%)					
	Questions	**Final year**	**Interns**	**Total**	***p* value**
1.	This subject has taught me that I am a member of a team offering oral health services				
	Agree	96.6	90.6	92.9	0.67
	Disagree	3.4	3.1	3.2	
	Uncertain	0.0	6.3	3.9	
2.	This subject has taught me that I have chosen an important profession for the oral health of the community				
	Agree	91.5	85.4	87.7	0.78
	Disagree	3.4	6.3	5.2	
	Uncertain	5.1	8.3	7.1	
3.	In this subject we learned that preventive care aims at reducing diseases and injuries in the community				
	Agree	91.5	82.3	85.8	0.08
	Disagree	5.1	4.2	4.5	
	Uncertain	3.4	13.5	9.7	
4.	This subject has taught me ways to protect against oral diseases				
	Agree	91.5	82.3	85.8	0.06
	Disagree	1.7	4.2	3.2	
	Uncertain	6.8	13.5	11.0	
5.	This subject has helped me to understand the oral health levels of the community				
	Agree	89.8	80.2	83.9	0.71
	Disagree	3.4	6.3	5.2	
	Uncertain	6.8	13.5	11.0	
6.	This subject has shown me the primary oral health problems of the community				
	Agree	88.1	83.3	85.2	0.12
	Disagree	5.1	4.2	4.5	
	Uncertain	6.8	12.5	10.3	
7.	What I have learned in this subject will be helpful in my professional life				
	Agree	88.1	78.1	81.9	0.08
	Disagree	6.8	6.3	6.5	
	Uncertain	5.1	15.6	11.6	
8.	This subject has taught me that a holistic approach is required in oral health and oral health education				
	Agree	83.1	77.1	79.4	0.81
	Disagree	6.8	7.3	7.1	
	Uncertain	10.2	15.6	13.5	
9.	This subject has contributed to gaining critical thinking and problem solving skills				
	Agree	81.4	69.8	74.2	0.04
	Disagree	6.8	12.5	10.3	
	Uncertain	11.9	17.7	15.5	

	Questions	Final year	Interns	Total	*p* value
10.	This subject has taught me that while treating oral diseases, many factors such as the social and economic conditions of the individual should be taken into consideration				
	Agree	79.7	90.6	86.5	0.03
	Disagree	15.3	3.1	7.7	
	Uncertain	5.1	6.3	5.8	

Table 2: The distribution of students who stated that they agreed with preventive care (%)

	Questions	Final year	Interns	Total	*p* value
11.	I am more interested in treatment services than preventive care				
	Agree	30.5	44.8	39.4	0.07
	Disagree	54.2	35.4	42.6	
	Uncertain	15.3	19.8	18.1	
12.	Preventive care is primary for the oral health of community				
	Agree	96.6	86.5	90.3	0.08
	Disagree	3.4	5.2	4.5	
	Uncertain	0.0	8.3	5.2	
13.	I have a professional responsibility to prevent oral diseases				
	Agree	94.9	87.5	90.3	0.87
	Disagree	1.7	6.3	4.5	
	Uncertain	3.4	6.3	5.2	
14.	Preventive care will have an important place in my professional life				
	Agree	91.5	87.5	89.0	0.98
	Disagree	6.8	4.2	5.2	
	Uncertain	1.7	8.3	5.8	

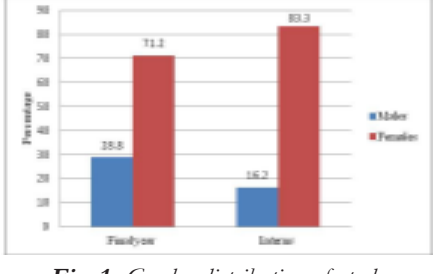

Fig 1: *Gender distribution of study participants*

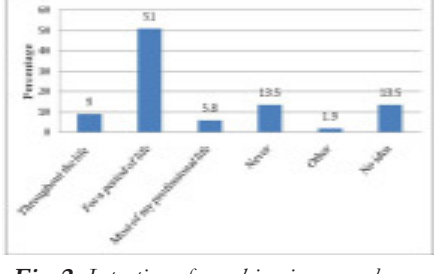

Fig 2: *Intention of working in a rural area at any time in their professional life*

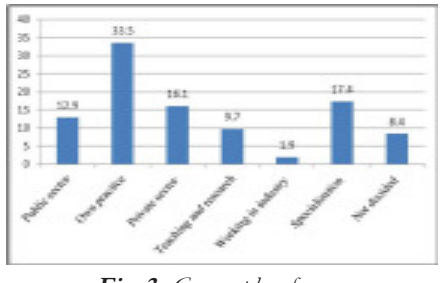

Fig 3: *Career plan for my professional life*

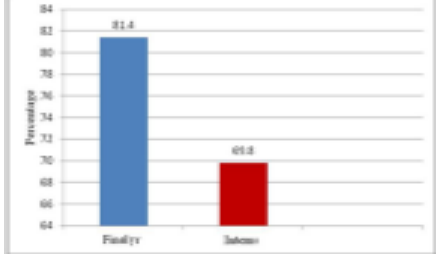

Fig 4: *Participants who agreed that this subject has contributed in gaining critical thinking and problem solving skills*

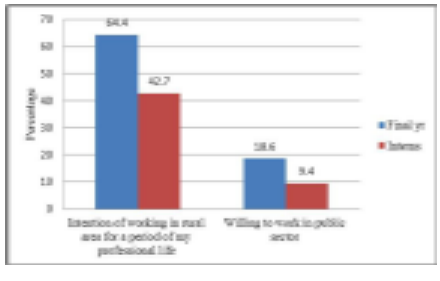

Fig 5: *Comparison of responses between final years and interns*

Effective esthetic management of midline diastema – Case Reports

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Abstract

Successful closure of diastemas with fixed dental prosthesis requires careful pre-treatment planning. Multiple options are available to treat the problems arising in the zone of high aesthetic sensitivity, every treatment modality offering some advantages and disadvantages. The objective of this article is to demonstrate how bonded porcelain restorations can produce beautiful results while preserving the strength of the original tooth.

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Key words: Diastema closure, aesthetics, dental ceramics, laminate veneers.

Introduction

An individual's personality is enhanced exponentially by his confident and captivating smile.[1] The increasing awareness worldwide of the importance of a captivating smile has lead to the evolution of Cosmetic and Esthetic Dentistry.[2] The concept of esthetics is essentially a judgment about beauty and the sublime.[3]

Tooth size discrepancy, discolorations, staining, fractures in teeth, endodontic treatment and smile designing are some of the reasons for which patients seek esthetic dental treatment.[1] Diastema is a commonly occurring aberration in the anterior esthetic zone. Correct diagnosis and planning are essential because the etiology of diastema is complex and multifactorial. It could include periodontal attachment loss, pressure from the inflamed tissue, occlusal factors such as trauma from occlusion, oral habits (such as bruxism, mouth breathing, tongue thrusting, sucking habits, developmental abnormalities (peg lateral), abnormal labial frenum, non-replacement of missing teeth, gingival overgrowth, and iatrogenic factors.[4] Successful closure of anterior diastemas with fixed prosthetic restorations requires careful treatment planning. Approaching the case with a physiologic perspective enables the restorative team to use powerful tools to creatively and predictably deal with the aesthetic challenge at hand. Choice of material, preparation design, and restorative protocol are important parameters to consider prior to treatment. Based on natural anatomy, a Biomimetic Analysis gives the restorative team a judicious understanding of the aesthetic parameters that should be recreated in the restoration.[5]

Conflict of interest and source of funding

The authors declare that there is no conflict of interest concerning the contents of the study.

This study has been self-supported by the authors.

Diastema closures can be placed into 3 classifications according to the biomimetic principles:

- Class I diastema closures are effectively treated by creating physiologic contact between the clinical crowns of 2 abutted teeth whose length to width dimensions are within natural proportions and the interdental crestal bone can properly support physiologic periodontal form.

- Class II diastema closures are between the clinical crowns of 2 abutted teeth whose length to width dimensions are within natural proportions and whose interdental crestal bone will not support proper periodontal form when the contact between abutted clinical crowns is created in a physiologic position. They can be effectively treated by acknowledging that positioning an anatomic contact between 2 abutted teeth will result in a black triangle beneath the contact which can be avoided by incorporating the creation of prosthetic gingiva to mimic proper physiologic gingival contour.

- Class III diastema closures are between the clinical crowns of 2 abutted teeth whose length to width dimensions are not within natural proportions and whose interdental crestal bone will not support proper periodontal form when the contact between abutted clinical crowns is created in a physiologic position. They cannot be effectively treated without orthodontic movement to close the interdental space.[5]

Case report 1

A 47 year old female reported to the Department of Prosthodontics, Crown and Bridge, Terna Dental College, Nerul, Navi Mumbai with a chief complaint of spaces between her front teeth (Fig 1 & 2). Patient's medical history was non-contributory and extra-oral examination indicated the 4 mm of tooth display and diastema between maxillary central and lateral incisors (Diastema classification Class II). Severe flaring of incisors was also noticed. She was an esthetically

Fig 1 & 2: *Preoperative intraoral views showing diastema and flaring*

Fig 3: *Preparation of 11, 21 to receive complete veneer all ceramic crowns*

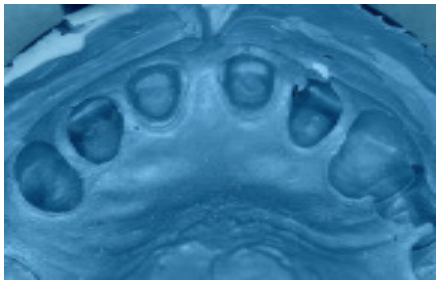

Fig 4: *Elastomeric final impression*

sensitive patient with a high lip line and refused any fixed orthodontic treatment for smile correction.

After effective communication with the patient, the definitive treatment plan included closure of the space between maxillary central incisors and aligning maxillary incisors to proper position with full veneer ceramic crowns, while placing proximal direct composite restorations on the lateral incisors. Preliminary treatment included oral hygiene instructions, non-surgical periodontal therapy and root canal treatment of teeth 11 and 21. Maxillary and mandibular alginate impressions were made for fabrication of study casts. A wax mockup was carried out and adjusted for anterior guidance on a semi adjustable articulator (Hanau™ Wide-Vue, Arcon articulator, Whipmix® Corporation). A smile with a high lip line and large spaces posed some special challenges. Careful attention to the details of interproximal emergence profiles, biologic width, and papillary height was necessary to get the desired esthetic results.[6] A circumferential 1 mm width of shoulder margin was prepared for complete veneer ceramic crowns of maxillary central incisors (Fig 3). The provisional restorations were fabricated according to the diagnostic wax up and modified to the patient's satisfaction. To verify adequate tooth length and appearance, a phonetic test (including F and S sounds) and an esthetic test (including tooth proportion, alignment, and color) were evaluated. Direct composite restorations using a putty index of the mock wax-up were carried out for the maxillary lateral incisors.

After adequate adjustment to the provisional restorations, the definitive impression was made using vinyl polysiloxane impression material (Aquasil, Dentsply/ Caulk, Milford, DE) (Fig 4). The impression was poured with type III dental stone and a master cast was fabricated. Ceramic crowns (Zirconia core layered with IPS E.max, Ivoclar-Vivadent) were fabricated for the maxillary central incisors. The definitive restorations were checked and adjusted in order to obtain optimal proximal contact, ideal gingival contour, and occlusal contact. They were then cemented with dual-cure resin cement (Variolink N®, Ivoclar Vivadent). Even contacts at maximum intercuspation and adequate anterior guidance of the maxillary central and lateral incisors were achieved. A maintenance plan, which included oral hygiene instruction and prosthesis home care, was established. The patient was well pleased with the esthetic results.

Case report 2

A 42 year old male patient reported to the Department of Prosthodontics, Crown and Bridge, Terna Dental College, Nerul, Navi Mumbai with a chief complaint of gaps between his front teeth. He had diastemata between teeth 11, 12 and 21 (Diastema classification Class I) but had satisfactory occlusion and overjet. After clinical examination, radiographs, photographs, study casts, and diagnostic wax setup were performed. Based on our evaluation, we decided on a conservative treatment approach using indirect metal free ceramic veneers. To achieve complete closure of the diastema (avoiding black triangles) and to achieve appropriate crown width:height ratio, the marginal gingival was contoured with the help of soft tissue laser prior to preparation for laminates (Figs 7 & 8).

For the intraoral mock-up, the silicone matrix fabricated on the waxup was filled with bis-acrylic composite resin (Protemp 4, 3M ESPE) and placed into position. Esthetics, symmetry, and occlusal high spots were analyzed (Fig 9). Conservative preparation in enamel was done through the composite mockup using a depth

Fig 5: *Preoperative smile*

Fig 6: *Postoperative smile*

Fig 7: *Before soft tissue contouring for ideal placement of gingival zenith with 11 and 21*

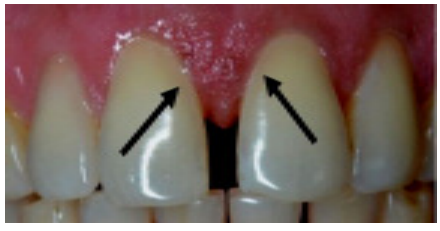

Fig 8: *After soft tissue contouring for ideal placement of gingival zenith with 11 and 21*

cutting bur as a guide. At the same appointment, the impression was made, using addition silicone (Express putty, 3M ESPE). Gingival displacement was done using retraction cord (#000 and #00, Ultradent) (Figs 11 & 12). Provisionalization was done with bis-acrylic composite resin (Protemp 4, 3M ESPE). IPS e.max veneers were then fabricated.

The internal surfaces of the veneers were etched with hydrofluoric acid for 20 seconds and silanized with a silane coupling agent. The enamel was conditioned with 37% phosphoric acid for 30 seconds after which the adhesive agent was applied. Resin cement (Variolink N®, Ivoclar Vivadent) was used to cement the veneers and each surface was photo-activated for 60 seconds. Occlusal contacts were marked, and protrusive and lateral movements were checked. The final appearance is shown in Figs 12 & 14.

Discussion

An interdisciplinary approach involving various disciplines of dentistry is necessary to evaluate and solve esthetic problems.[4] Based on case requirement, orthodontic closure can be used for redistribution of spaces between incisors to create spaces more favorable for restorative closure. Periodontal intervention can be of assistance in the displacement of frenal attachment or modification of gingival contours to achieve ideal aesthetic results. In an esthetically sensitive patient, even a slightly asymmetrical papilla can be a cause of concern. Tooth size can be increased apically by crown lengthening procedures or incisally by restoration within physiologic limits. In extreme cases the entire vertical dimension of occlusion may need to be altered to achieve the desired length. The mesiodistal tooth position itself is another important consideration, especially in a case where there is a high lip line. The restorative closure of diastema can be achieved by using any of the following techniques - direct composite veneers, indirect composite veneers, porcelain laminate veneers, all ceramic crowns, metal ceramic crowns and composite crowns.[1]

Direct restoration with composite resin has advantages such as conservation of tooth structure, low cost, reversibility, and a relatively simple technique. However, for extensive tooth reconstruction, composites have a high failure rate, averaging 2.9% annually. This can be due to secondary caries, loss of restoration, pigment impregnation, fracture, marginal defects, or a high degree of color instability.[3] Ceramics are the preferred choice of material due to their predictable esthetics and long-lasting results. Improvements in dental materials have made metal free ceramics a desirable option for indirect esthetic restorative procedures, especially in the form of veneers. IPS.emax laminate veneers in addition to their inherent translucency, have compressive strength, surface smoothness, abrasion resistance, gloss and low plaque accumulation.[3]

Porcelain laminate veneers (PLV) were introduced into dentistry around 1938 (Pincus, 1938). With the introduction of acid etch technique by Buonocore (1955) and silica resin direct filling material by Bowen (1958), interest was generated in PLV. Coupled with silanization of veneers and the introduction in the early 1980s of bonded porcelain veneer (Horn, 1983), the results with PLV have become more predictable. Survival rates have ranged from 92% at 5 years to 64 % at 10 years. Carefully placed PLV have reported very high survival rates of over 90% after 9 years stressing the need for the proper case selection and technique.[1]

However, porcelain laminates have their own limitations too. They should not be used when remaining enamel is

Fig 9: *Composite mockup*

Fig 10: *Preparation of 11, 21 to receive ceramic laminate veneers*

Fig 11: *Preoperative intraoral view*

Fig 12: *Postoperative intraoral view*

Fig 13: *Preoperative smile*

Fig 14: *Postoperative smile*

inadequate to provide adequate retention. Large Class IV defects should probably not be restored with veneers because of the large amount of unsupported porcelain and the lack of tooth-colored backing. The amount of unsupported porcelain should be carefully evaluated in cases with a large diastema. Darkly stained teeth are not optimally restored with veneers. The prognosis for veneers in bruxing is doubtful. Certainly, such patients should be instructed to use a night guard after final restoration (Sheets & Taniguchi, 1990). Even, if the laminates fail in the long run, the conserved tooth can still be treated with a full crown restoration.[1]

Conclusion

The specific goals of treating diastema are: creating a tooth form in harmony with adjacent teeth, arch and facial form; maintaining an environment for excellent gingival health; and attainment of a stable and functional occlusion.[7] It has become increasingly apparent that conservation of tooth structure is a major factor in determining the long-term prognosis of any restorative procedure. Laminates are an esthetic and conservative alternative for diastema closure through little or no tooth structure loss. However certain cases demand a more radical approach. Detailed planning, selection of the appropriate dental materials, and quality communication with the technician contributes to a harmonious smile and the evident satisfaction of our patients.

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Mucoepidermoid carcinoma of palate: A case report

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Abstract

Mucoepidermoid carcinoma (MEC) is the most common malignant salivary gland tumor, first studied and described as a separate distinct pathologic entity by Stewart et al in 1945.[1] It consists of both epidermoid and mucous cells in varying proportion, hence the name. The parotid gland is the most commonly affected gland followed by the minor salivary glands of the palate. Although no specific etiologic factors have been identified, exposure to ionizing radiation has been reported in some cases.[2] The prognosis is based upon the clinical stage and histological grade. We present a case of mucoepidermoid carcinoma of the palate mimicking a cystic lesion.

(Terna J Dent Sci 2014;3(1):27-29)

Key words: Mucoepidermoid carcinoma, aspiration biopsy, enucleation

Introduction

"A malignant epithelial tumor composed of varying proportions of epidermoid, mucous, intermediate, columnar and clear cells that often demonstrate prominent cystic growth. On the basis of morphologic and cytologic features it is divided into low, intermediate and high grade types" is how Ellis and Auclair[2] described mucoepidermoid carcinoma (MEC). Mucoepidermoid carcinoma (MEC) is a malignant epithelial neoplasm composed of varying proportions of mucous, epidermoid, intermediate, columnar, clear cells and often demonstrates prominent cystic growth.

It accounts for less than 10% of all salivary gland tumors. About 2/3rds arise within the parotid gland and 1/3rds arise within the minor salivary glands. It may develop at any age[3] but occurs most frequently between the third and sixth decades and affects women more often than men (3:2).

MEC displays a variety of biological behaviors, and while the high-grade MEC is a highly aggressive tumor, its low-grade counterpart usually demonstrates a more benign nature. The prognosis of MEC varies[4] depending on the clinical stage and histological grade. The main therapeutic method in the treatment of MEC, like in most types of salivary gland malignancies, is surgical resection and postoperative radiotherapy.

Case Report

A 21 years old male patient came with chief complaint of swelling over right palatal region since 5-6 yrs and he noticed a sudden increase in its size since 4 days. The swelling was present since 5-6 years and was gradually increasing in size (Fig 1).

The swelling extended from 12 to 17, was oval in shape, well demarcated and bluish in colour. It was painless and not associated with any draining sinus. Diagnostic orthopantomograph (Fig 2) and occlusal view radiograph (Fig 3) showed no abnormalities. Aspiration of the lesion was done and 2 ml of cheesy, blood tinged fluid was aspirated (Fig 4). Histopathologic analysis of the aspirate showed mucoid cells and was inconclusive. Enucleation of the lesion was planned and the procedure was explained to the patient. Routine laboratory parameters were normal and the patient was posted for surgery after proper consent. After achieving adequate local anesthesia, intraoral crevicular incision was given in the palatal region extending from 12 to 17. Mucoperiosteal flap was refelected and the lining of the lesion was visualised (Fig 5).

The lining was carefully separated from the surrounding structures and excised (Fig 6) in toto. The same was sent for histo-pathological examination. The wound was sutured with 3-0 black silk after thorough curettage of the bony palate and palatal mucosa (Fig.7). The patient was prescribed postoperative antibiotics, analgesics and mouthwashes to maintain his oral hygiene and was called for a regular follow-up.

Conflict of interest and source of funding

The authors declare that there is no conflict of interest concerning the contents of the study.

This study has been self-supported by the authors.

Histopathologic report

The haematoxylin and eosin stained slide showed cystic spaces filled with mucin in a background of connective tissue stroma. The cystic spaces were lined by mucous and epidermoid cells. Cellular

Fig 1: *Intraoral view showing the swelling in the palatal region*

Fig 2: *Diagnostic orthopantomograph*

Fig 3: *Maxillary occlusal view showing normal anatomy*

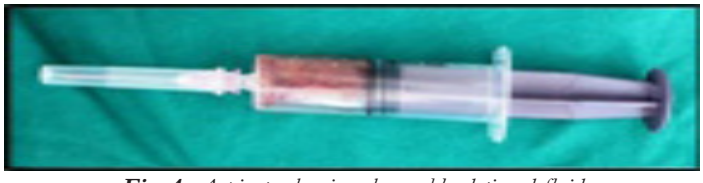

Fig 4: *Aspirate showing cheesy, blood tinged fluid*

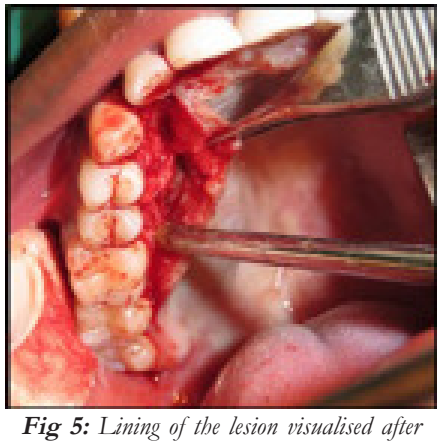

Fig 5: *Lining of the lesion visualised after mucoperiosteal flap reflection*

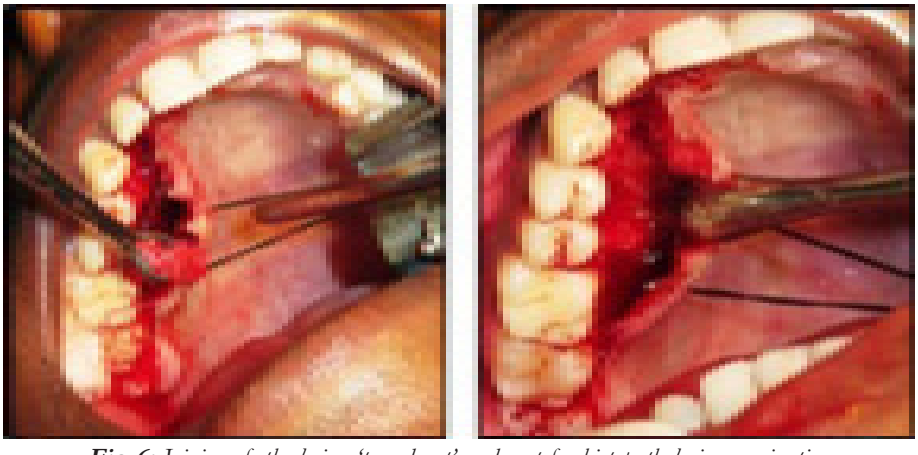

Fig 6: *Lining of the lesion 'teased out' and sent for histopathologic examination*

Fig 7: *Immediate postoperative after suturing with 3-0 black silk with pathological specimen*

atypia was noted at some sites and were suggestive of low to moderate grade mucoepidermoid carcinoma (Fig 8). The patient was referred to a higher institute for further treatment protocols.

Discussion

Mucoepidermoid carcinoma was first described by Massao and Berger in 1942.[5] Mucoepidermoid carcinoma of salivary gland is believed to arise from pluripotent reserve cells of excretory ducts that are capable of differentiating into squamous, columnar, and mucous cells. Subsequent metastasis of few of previously benign tumors has led to all mucoepidermoid tumors being considered as carcinoma.[6] It occurs commonly in parotid glands with minor glands being second most common site. Although these account for less than 10% of all tumors of salivary glands, it constitutes approximately 30% of all malignant tumors of salivary glands.

Clinically, the majority of palatal mucoepidermoid carcinoma appears as firm swellings and may mimic mucoceles or vascular lesions.[7] The mucosa overlying the palatal tumors can be papillary and the cortical bone may display superficial erosion. The lesions usually are painless; however, symptoms can include pain, paresthesia, dysphagia and bleeding. Clinical findings and investigations in the present case indicated a surface lesion. Blue to red color of the lesion may

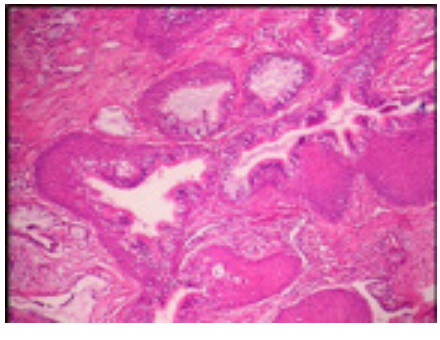

Fig 8: *Histopathologic section showing mucous, and serous cells with cellular atypia characteristic of mucoepidermoid carcinoma*

suggest vascular or salivary gland origin. This can be attributed partly to the cystic spaces of tumor associated vascular ectasia.

The microscopic appearance of mucoepidermoid carcinoma depends greatly on the histologic grade of diûerentiation.[8] Prominent cystic structures, multiple well-developed cystic or microcystic structures are lined by mature mucin-producing, intermediate or epidermoid cells are the hallmark of low grade mucoepidermoid carcinoma.[8] Quantitatively, mucous cells are more prevalent in low-grade than in intermediate-grade and high-grade tumors. Solid cellular areas are not prominent and constitute less than 10% of the tumor. Keratinization is seldom found. Microcystic formations coalescing into larger cysts are often prominent. A prominent fibrous stroma is often present.[9,10] The growth pattern of low-grade carcinomas is generally a broad advancing front; they are not highly invasive.

Intermediate-grade lesions have fewer and smaller cysts than do low-grade lesions. Intermediate cells predominate and form solid islands. Slight to moderate cellular pleomorphism and occasional mitotic figures are rare, but nucleoli are noted more often in intermediate-grade than low-grade lesions. The distinction between intermediate-grade and low-grade tumors is based on the relative proportion of cystic and solid cellular areas and the predominance of intermediate and epidermoid cells in intermediate-grade tumors.[11, 12] Unlike low-grade tumors, intermediate-grade tumors usually have invasive borders.

High-grade carcinomas are characterized by predominantly solid cellular proliferations of epidermoid and intermediate cells, with higher degrees of atypia, anaplasia, multiple mitoses, and necrosis. These are infiltrative tumors in which perineural and lymphovascular invasion is easily found.[13, 14] High-grade carcinomas have scanty mucin production; thus, a careful search and special stains may be required to identify it.

Complete excision of the lesion with free surgical margins is the treatment of choice and the one that offers the best local control of the disease. However, the frozen section assessment of mucoepidermoid carcinoma surgical margins may be difficult because of ductal hyperplasia and squamous metaplasia in salivary gland tissue adjacent to the tumor and because microscopic islands of tumor may extend beyond the grossly discernible tumor mass. Parotid tumors should be treated by parotidectomy, with preservation of the facial nerve; however, if the cervical lymph nodes are involved, neck dissection is indicated. For tumors of the submandibular gland, dissection of the triangle is recommended, and if cervical nodes are involved, a neck dissection is indicated. For carcinomas of the minor glands, complete excision with normal tissue margins is the ideal treatment.

Radiation therapy is indicated for high-grade carcinomas, stage III and IV tumors, tumors with extensive perineural or vascular invasion, tumors of the deep lobe of the parotid gland or base of the tongue, and incompletely excised tumors. The role of chemotherapy in the treatment of salivary mucoepidermoid carcinoma remains speculative. However, with the emergence of molecular targeted therapy, salivary gland carcinomas are an optimal candidate for clinical trials of investigational and established drugs for other indications.[14]

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A rare case of a dentigerous cyst associated with an impacted maxillary supernumerary premolar: A case report

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Abstract

Odontogenic developmental cysts of jaws usually presents as asymptomatic lesions. Dentigerous cyst is one of the varieties of these cysts which may grow to a large size intraosseously within jaws before it manifests clinically. Numerous immunohistochemical and molecular marker studies have been carried out for this lesion to understand its etiopathogenesis and aggressive behaviour. Another reason being, its potential to turn malignant. We present a rare case of dentigerous cyst associated with an impacted maxillary premolar which was a supernumerary tooth and manifested as a unilateral swelling in the midface region. **(Terna J Dent Sci 2014;3(1):30-32)**

Key words: Dentigerous cyst, aspiration, enucleation

Introduction

Dentigerous or follicular cysts (DC) are those that involve an odontogenic epithelial origin and are due to developmental alterations.[1] They are the most frequent type (10%) after radicular cysts (25%) and are linked to cases of unerupted teeth.[2] The origin of this type of cyst lies in the reduced enamel epithelium, as a result of a cystic degeneration of the remaining enamel organ, generating a fluid accumulation caused by the degeneration of epithelial cells, identified by means of exudation between the crown and the epithelium.

The diagnostic feature of this cyst is the presence of the unerupted tooth in its cavity (Johnson et al.,1994). It is most frequently associated with mandibular third molar, maxillary canine, mandibular premolar and maxillary third molar in decreasing order of frequency (Jones et al.,2006).[3] These cysts are generally found by chance after a routine x-ray. These cysts normally appear in young adults, between 20 and 30 years of age. Stafne was the first to describe dentigerous cysts associated with supernumerary teeth, registering an incidence of 5.5% in 200 dentigerous cysts.[4] Treatment includes enucleation of the cyst with the removal of the unerupted tooth. Marsupialization is occasionally done with very large cyst to decompress it.[5] Prognosis is excellent and recurrence is rare if completely removed.

Conflict of interest and source of funding
The authors declare that there is no conflict of interest concerning the contents of the study.
This study has been self-supported by the authors.

Case Report

A 47 year old female patient came with complaint of swelling, in maxillary left vestibular region, since 2 weeks. Extraoral exam revealed a midface swelling situated lateral to the nose on the left side. Intraorally, swelling extended in the left buccal vestibular region extending from mesial aspect of 23 to distal aspect of 25 (Fig. 1).

The swelling was painless, soft on palpation, nontender and nonfluctuant. Diagnostic orthopantomograph (Fig. 2) and occlusal view radiographs (Fig. 3) showed unilocular lesion in the left maxillary sinus region associated with crown of an unerupted supernumerary tooth. Aspiration of the lesion was done and 1 ml of cystic fluid was aspirated (Fig. 4). Histopathologic analysis of the aspirate suggested an infected dental cyst. Routine laboratory investigations were advised and 3d CT scan was suggested to visualise the exact extent of the lesion (Fig. 5).

Routine laboratory parameters were normal and the patient was posted for surgery after obtaining proper consent. After achieving proper anaesthesia, intraoral mucoperiosteal incision using blade no. 15 was made in the buccal vestibule extending from 23 to 26. The mucoperiosteal flap was gently sepearated and reflected to visualize the cystic lining (Fig. 6). Aspiration was again done to relieve the intracystic pressure. The cystic lining was carefully enucleated in toto along with the associated supernumerary premolar and sent for histopathologic examination (Fig. 7).

The bony cavity was seen and the wound margins were sutured (Fig. 8).

Histopathologic diagnosis:

Histopathologic sections showed thin cystic lining with no retepegs, resembling reduced enamel epithelium. The delicate connective tissue stroma showed features of primitive ectomesenchyme suggestive of dentigerous cyst (Fig. 9).

The patient was recalled for periodic follow-up (Fig. 10).

Discussion

A dentigerous cyst encloses the crown of an unerupted tooth by expansion of the follicle, which is attached to its neck. Dentigerous cysts are associated with an

Fig 1: *Intraoral view showing the swelling extending from 23 to 25*

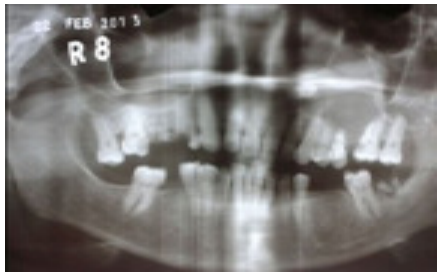

Fig 2: *Diagnostic orthopantamograph showing the lesion*

Fig 3: *Maxillary occlusal view showing the association of the lesion with a supernumary tooth*

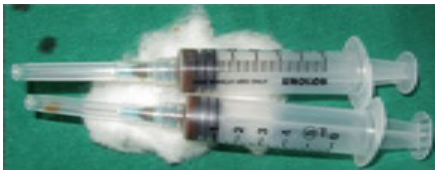

Fig 4: *1 ml of aspirate collected*

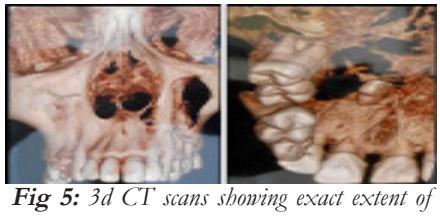

Fig 5: *3d CT scans showing exact extent of the lesion*

Fig 6: *Cystic lining after incision and mucoperiosteal flap refelection*

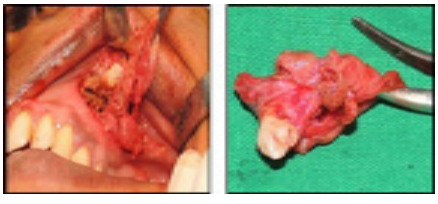

Fig 7: *Cystic lining enucleated with the associated maxillary supernumerary premolar*

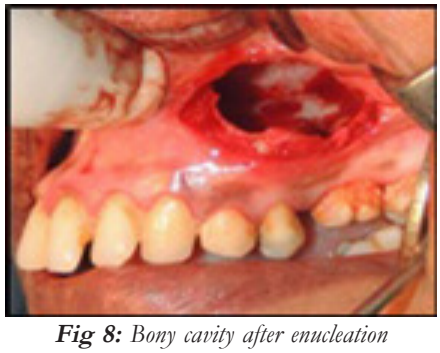

Fig 8: *Bony cavity after enucleation*

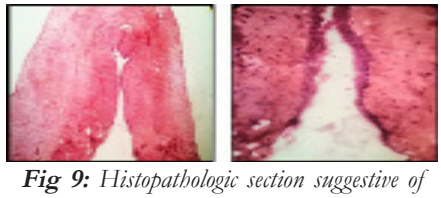

Fig 9: *Histopathologic section suggestive of dentigerous cyst*

Fig 10: *Healing at 6 months follow-up*

unerupted tooth. In order of its frequency, they are associated with mandibular third molars, maxillary canines, mandibular second premolars and maxillary third molars (Neville et al, 2006).[6] They may also occur around supernumerary teeth, however, they are only rarely associated with primary teeth (Neville et al, 2002; Kusukawa et al, 1992). In our case it was related to a permanent maxillary supernumarary premolar. The incidence of such a case in literature is less than 1% making this case a rare finding. Dentigerous cysts are most frequently found in individuals in the age group between twenty and forty years. Our patient was 47 years old.

These cysts can grow to a very large size and can cause displacement of teeth, or in few cases it may remain relatively small.[7] Many dentigerous cysts are small asymptomatic lesions that are discovered serendipitously on routine radiographs, although some may grow to considerable size causing bony expansion that is usually painless until secondary infection occurs. Since cysts can attain considerable size with minimal or no symptoms, early detection and removal of the cysts is important to reduce morbidity. Moreover, almost all of the reported cases (Swerdloff et al , 1980)[8] including the present case, presented without pain and discovered during investigation of asymptomatic slowly-growing swellings.

Radiographically, the dentigerous cyst presents as a well-defined unilocular radiolucency, often with a sclerotic border. Since the epithelial lining is derived from the reduced enamel epithelium, this radiolucency typically and preferentially surrounds the crown of the tooth.[9] A large dentigerous cyst may give the impression of a multilocular process because of the persistence of bone trabeculae within the radiolucency. However, dentigerous cysts are grossly and histopathologically unilocular processes and probably are never truly multilocular lesions (Shear 2007).

Three types of dentigerous cyst have been described radiographically: The central variety, in which the radiolucency surrounds just the crown of the tooth, with the crown projecting into the cyst lumen. In the lateral variety, the cyst develops laterally along the tooth root and partially surrounds the crown, the circumferential variant exists when the cyst surrounds the crown but also extends down along the root surface, as if the entire tooth is located within the cyst.[10] Our case was radiographically a classic presentation of the circumferential variety.

The histological features of dentigerous cysts may vary greatly depending mainly on whether or not the cyst is inflamed. In the non-inflamed dentigerous cyst, a thin epithelial lining may be present with the fibrous connective tissue wall loosely arranged. As the lining is derived from reduced enamel epithelium, it is 2-4 cell layer thick and of primitive type. The cells are cuboidal or low columnar. Retepeg formation is absent except in cases that are secondarily infected. As the connective tissue wall is derived from the dental follicle of developing enamel organ, it is a loose connective tissue stroma which is rich in acid mucopolysaccharides.[11] In the inflamed dentigerous cyst, the epithelium commonly demonstrates hyperplastic rete ridges, and the fibrous cyst wall shows an inflammatory infiltrate. Young fibroblasts are present in the stroma. The cell lining may show metaplastic changes in the form of mucous producing cells or secretory cells such as goblet cells. Pseudostratified ciliated columnar epithelium has also been reported. Rarely sebaceous glands in the walls are observed. The content of the cystic lumen is usually thin watery yellow fluid and is occasionally blood tinged.[12]

Histopathogenesis of dentigerous cyst is based on intrafollicular and extrafollicular theories. There can be no good reason for the extrafollicular theory of origin of dentigerous cysts, as the evidence is that those reported as arising in this manner all appear to been envelopmental or follicular odontogenic keratocyst (Shear, 2007). Intrafollicular theory postulates the possibility of cyst formation due to fluid accumulation between the layers of inner and outer enamel epithelium after the formation of crown. Another possibility is due to degeneration of stellate reticulum at an early stage of tooth development resulting into cyst formation associated with enamel hypoplasia (Al-Tabani & Smith, 1980).

Main's theory (1970): The impacted tooth exerts pressure on the follicle which obstructs the venous outflow and induces rapid transudation of serum across the capillary walls. The increased hydrostatic pressure exerted by this pooling of fluid causes separation of crown from the follicle with or without reduced enamel epithelium.

The osmolality of the cyst fluid is modified by increased permeability to glycosaminoglycans-like hyaluronic acid, heparin & chondroitin sulphate, which causes expansile growth rapidly (Browne & Smith et al, 1980).

Most dentigerous cysts are treated with enucleation of the cyst and removal of the associated tooth. Large dentigerous cysts may be treated with marsupialisation, when enucleation and curettage might otherwise result in neurosensory dysfunction or predispose the patient to an increased chance of pathological fracture.

Occasionally it transforms to squamous cell carcinoma, mucoepidermoid carcinoma, or ameloblastoma (Banderas et al, 1996, Johnson et al, 1994; Eversole et al, 1975; Leider et al, 1985).[13] The prognosis for most histopathologically diagnosed dentigerous cysts is excellent, recurrence being a rare finding.[14] In all dentigerous cyst, the microscopic features must be determined, to rule out its transformation to an ameloblastoma or to squamous cell carcinoma.

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Lingual frenectomy using diode laser for Ankyloglossia: Our experience of 3 cases

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Abstract

Ankyloglossia is a congenital oral anomaly that can cause difficulty with deglutition, mastication, speech and breast feeding. For many years, the subject of ankyloglossia has been controversial, with practitioners of many specialties having widely different views regarding its significance and management. Here we present a series of three cases of ankyloglossia treated with lingual frenectomy using diode laser. **(Terna J Dent Sci 2014;3(1):33-35)**

Key words: Ankyloglossia, diode laser, frenectomy.

Introduction

Ankyloglossia is an oral anomaly characterized by the abnormal insertion of the lingual frenulum, which compresses the mucosa, dense connective tissue, and occasionally, superior fibers of the genioglossus muscle. In this case, protrusion and elevation of tongue in the direction of the palate was hindered by the tension on the short frenulum.[1] This pathology, diagnosed at birth, can persist until late childhood or even adulthood, and presents different patterns of insertion from the tip of the tongue to the lingual alveolar ridge.[2] The prevalence of ankyloglossia described in the literature ranges between 0.1% and 10.7%.[3,4] The main reason for this wide variation is the lack of definition among researchers when diagnosing ankyloglossia.

Table 1: Kotlow's Assesment		
Class I	mild ankyloglossia	12-16 mm
Class II	moderate ankyloglossia	8-11 mm
Class III	severe ankyloglossia	3-7 mm
Class IV	Complete ankyloglossia	<3mm

In observational epidemiologic studies of oral mucosa in general, the prevalence of ankyloglossia is generally lower (0.1–4%) than in studies related only to the prevalence of ankyloglossia (4–11%). The prevalence is also higher in studies that investigate newborns (2–11%) compared with studies reporting on children and adults (0.1–2%). Ankyloglossia can be diagnosed using the following criteria: impossibility of touching palate with tongue tip when the mouth is open; bifid tongue during protrusion; curvature of the intermediate part of the tongue, preventing it from moving forward out of the oral cavity.

Ankyloglossia varies in degree of severity from mild to severe cases. The ankyloglossia can be classified into four classes based on Kotlow's assessment as shown in the table 1[4]. A tongue-tie, can be observed in neonates, children or adults. Ankyloglossia can affect feeding, speech, and oral hygiene as well as have mechanical/ social effects. A patient of ankyloglossia demonstrates improper pronunciation of certain consonants and diphthongs ('letters such as t, d, r, n and l, in sounds and words such as ta, te, time, water, and cat, etc.)[4]. The treatment options for ankyloglossia involve observation, language articulation therapy and three possible surgical techniques: frenotomy, which consists of simply cutting the frenulum; frenectomy, complete excision of the frenulum; and frenuloplasty, which involves freeing the tongue and correcting its anatomy which can be done using conventional scalpel procedures or soft tissue lasers. LASER stands for "Light Amplification by Stimulated Emission of Radiation". The relative new semiconductor diode lasers are portable contact surgical units with efficient and reliable benefits. They are designed according to economic and ergonomic considerations and are economic in comparison to other hard tissue lasers. They can be used in continuous as well as pulse mode and according to clinical situation in contact and non-contact mode. The present series of cases describes the clinical effects of diode laser irradiation on oral tissue like lingual frenum and its compatibility in treating the same.

Conflict of interest and source of funding

The authors declare that there is no conflict of interest concerning the contents of the study.

This study has been self-supported by the authors.

Case report: 1

A 24 -year-old healthy male patient reported to the Dept. of Oral and Maxillofacial Surgery, Terna Dental College, with the complaint of difficulty in maintaining oral hygiene and inability to protrude the tongue. He had no relevant past medical history. Intraoral examination revealed – ankyloglossia-and

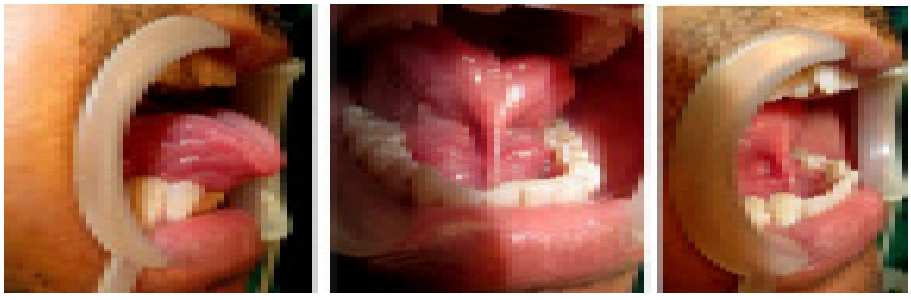

Fig1: *Pre-operative view (Case 1)*

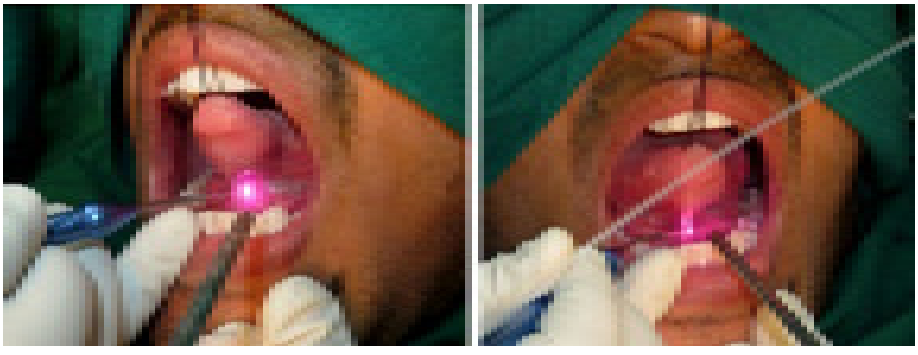

Fig 2: *Intraoperative view: diode laser in contact mode (Case 1)*

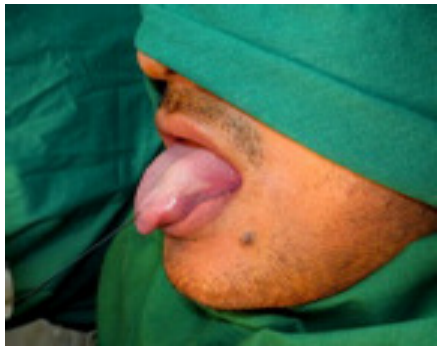

Fig 3: *Post-operative view (Case 1)*

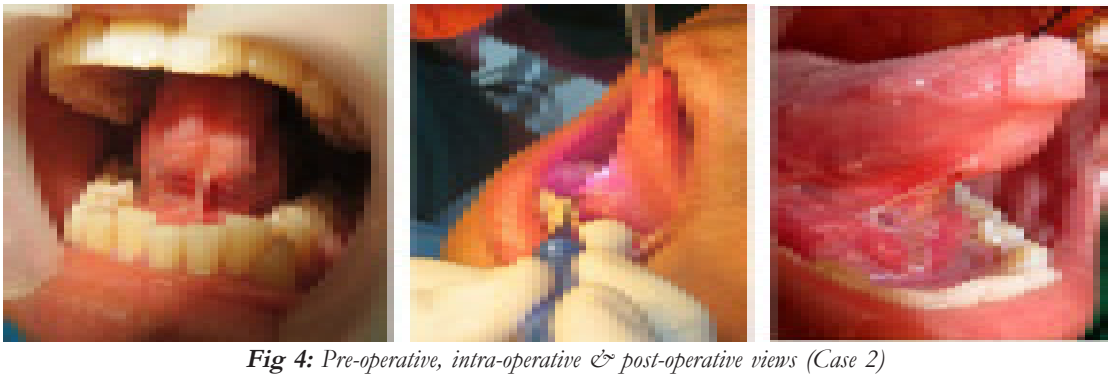

Fig 4: *Pre-operative, intra-operative & post-operative views (Case 2)*

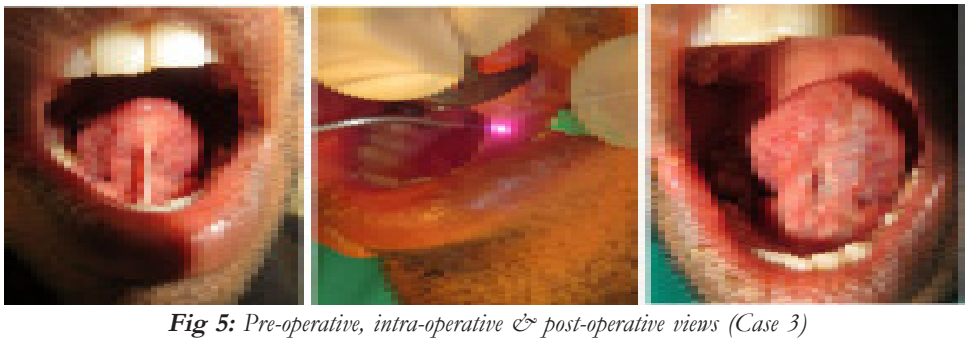

Fig 5: *Pre-operative, intra-operative & post-operative views (Case 3)*

was classified as moderate ankyloglossia according to Kotlow's classification (Fig.1). Lingual frenectomy was planned by using soft tissue diode laser. Informed consent was taken. The procedure was initiated by contacting fibreoptic tip into a piece of articulating paper at 2 W in a continuous mode. An initiated tip of 200 μm was used with an average power of 2-5 W in a continuous mode. The diode laser was applied in a contact mode with focused beam for excision of the tissue. The tip of the laser was moved from the apex of the frenum to the base in a brushing stroke cutting the frenum. The ablated tissue was continuously mopped using wet gauze piece.

This takes care of the charred tissue and prevents excessive thermal damage to the underlying soft tissues (Fig. 2). Protrusive tongue movement was checked (Fig.3). No suturing was done, and the patient was prescribed with antibiotics and analgesics. Patient was instructed to assess freeness of tongue through protruding and sweeping upper and lower lip and corner of the mouth without much straining. Patient was instructed to avoid spicy, hot and acidic food. Postoperative instructions were given and postoperative tongue physiotherapeutic exercises after first 24 hours were instructed.

Case report: 2

Similarly another patient, a 30 year old male reported to our Department with chief complaint of difficulty in speech. On examination he was found to have a tongue-tie (ankyglossia) for which he was explained about the lingual frenectomy procedure and informed consent was taken. 810nm diode laser under local anaesthesia (2% lignocaine and 1:80000 adrenaline) was used. The procedure was done as discussed above (Fig.4).

Case report: 3

This Patient was a 24 year old male who reported to the department for surgical removal of an impacted tooth and during history taking procedure he also complained of inability to move his tongue backwards to clean his posterior teeth. The procedure of lingual frenectomy was explained to him as obvious ankyloglossia was visible. This procedure (of lingual frenectomy using laser) was carried out after surgical removal of impacted tooth under local anaesthesia (Fig.5).

Discussion

Ankyloglossia is the most frequent developmental abnormality of the tongue, occurring in 0.2–20% of patients.[5] Although frenotomy is a more conservative procedure, it offers the undesirable possibility of fibers becoming reattached, requiring complementary procedures to release the tongue satisfactorily, such as; section of superficial genioglossus muscle, fibers, dissection of the lateral edge of the incision and gingivectomy. Frenectomy is a more invasive procedure, in an ambulatory environment, but its results are predictable, decreasing the recurrence rate.[6] We recommend the use of lasers for the release of the frenulum in young patients as their use reduces postoperative pain and swelling, and avoids unnecessary pain and postoperative complications, which, in our case, were negligible. The risk of postoperative bleeding was also considerably reduced compared with conventional methods,[7] and healing took less time than after scalpel dissection.[8] In our cases, two patients had complained of difficulty in protrusion of tongue and difficulty in speech due to tongue tie. The third patient during history taking for an impacted tooth, also had a specific complaint that he was unable to clean his posterior teeth using his tongue. He felt his tongue movements were inadequate. All the patients were satisfactorily treated with diode laser with minimum post-operative discomfort. Two patients who reported to us with difficulty in speech had considerable improvement after the procedure. Third patient felt his tongue movements had markedly improved and was satisfied after the procedure.

Lasers have the added advantage of maintaining a uniform depth in the surgical site, thereby reducing unnecessary damage to muscle, and their use obviates the need for sutures. The radiation of a diode laser shows a greater absorption and a smaller penetration depth than that of a Nd:YAG laser, especially in blood-rich tissue. The wavelength of the diode laser is considerably more absorbed due to hemoglobin than that of the Nd:YAG laser. This causes not only a better incision performance but also an excellent coagulation of tissue. The thickness of the charring layer, the coagulation layer and incision depth, are similar for the diode laser and the Nd:YAG laser with the same laser settings. Advantages of the diode laser seen in our clinical routine are that it requires no or minimal anaesthetics and that the wounds heal softly. One characteristic difference from the diode laser is that, no trend of greater damage to lateral tissues with the constant wave mode at higher power levels can be observed. Also, no charring of bone underlying 0.8-mm-thick soft tissue was observed with the continuous wave mode, or with the pulsed mode at an average power of 4-5 W. Histologically, laser wounds have been found to contain significantly lower number of myofibroblasts[9] resulting in less wound contraction and scarring, and ultimately improved healing, with better postoperative perception of pain and function than with the scalpel technique.[10]

Conclusion

Thus it was concluded that the clinical application of diode laser in surgical treatment of Ankyloglossia seems to be beneficial in daily practice. On the basis of our experience with the use of Laser in frenectomy we are carrying out a comparative study between the use of scalpel and diode lasers in frenectomy procedure. .

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Implant-retained partial overdenture with locator attachments: A case report

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Abstract

Prosthetic management of partial edentulism has always been a challenge due to variability that affects esthetic and functional outcome. The use of implants for management of partial edentulism has been a successful prosthetic treatment option. This case report describes in detail the planning, designing and fabrication of implant - retained partial overdenture. The mandibular implant supported overdenture with locator attachments will drastically improve patient's comfort and oral function. This will aid in achieving a great deal of satisfaction for both the patient as well as the clinician.

(Terna J Dent Sci 2014;3(1):36-40)

Key words: Implant-retained overdenture, locator attachment, balanced occlusion

Introduction

Prosthetic management of partial edentulism has always been a challenge due to variability that affects esthetic and functional outcome. A removable partial denture (RPD) is indicated when an edentulous span is too large for replacement with a fixed partial denture (FPD) or when a large volume of supporting structures is required to be restored.[1] Some of the potential limitations of RPD treatment are the risk of developing caries, periodontal involvement of the abutment teeth, continuous ridge resorption and unesthetic appearance of the clasps.[1-3]

The introduction of implants has changed the conventional approach to prosthetic rehabilitation of partially edentulous patients and created treatment options deemed impossible to achieve in the past.[4] The use of implants for partial overdenture has been described recently in the literature as a successful prosthetic treatment option.[1]

Implant retained partial overdenture (IRPOD) involves placement of a limited number of implants that are capable of providing adequate retention and support for partially edentulous arches. The osseointegrated implants have aided in evolution of different attachments and prosthetic designs.[5,6] The purpose of this article is to present a case where an implant-retained partial overdenture (IRPOD) with locator attachments has been carried out as a convenient restorative option for rehabilitation of partially edentulous mandibular arch.

Conflict of interest and source of funding

The authors declare that there is no conflict of interest concerning the contents of the study.

This study has been self-supported by the authors.

Case report

A 52-year-old female patient reported to the Department of Prosthodontics with a chief complaint of missing teeth and desired a replacement for the same. A detailed medical and dental history was taken and an intra-oral examination was performed. Medical history revealed no significant findings. Dental examination revealed the following (Fig. 1).

Maxillary arch showed:

- Missing teeth –14 15 24 25.
- Carious teeth – 11 21 26.
- Post and core with porcelain fused to metal (PFM) crown on 12 fabricated 7 years ago.
- 4-unit acrylic facing fixed dental prothesis (FDP) with 13 14 15 16 fabricated 7 years ago. The acrylic had discolored and gingival recession around canine -13 led to exposure of margins cervically.
- Splinted PFM crowns – 22 and 23 fabricated 5 years ago.

Mandibular archs howed:

- Missing teeth – 35 36 46.
- Grossly carious teeth – 34 43 44 45.

Radiographic examination was carried out. OPG showed that all the teeth present were endodontically treated (Fig. 2). The condition of 34 43 44 45 was found to be non-restorable and so extraction was carried out. Periodontal opinion of the remaining teeth was taken and a thorough oral prophylaxis was performed.

Preliminary impressions were made and casts were poured. Facebow record was taken and transferred to the semi-adjustable articulator (Hanau Wide Vue). Anterior deprogramming was performed with Lucia jig (Fig. 3) and patient's centric relation was recorded using bimanual palpation method. The casts were mounted in centric relation on the semi-adjustable articulator. Cone beam computed tomography (CBCT) scan was advised to evaluate the quality and quantity of bone. The scan showed poor bone quality in the mandibular posterior region, so multiple implant placement was ruled out. The blood investigations of the patients were done to rule out any pathology.

Case was studied and different treatment options with fixed, removable and implant-retained prosthesis were given to the patient. Treatment options were

Fig 1: *Pre-operative photograph*

Fig 2: *OPG*

Fig 3: *Anterior deprogramming with Lucia Jig*

Fig 4: *Placement of stent for pilot drill*

Fig 5: *Implant placement and suturing done*

Fig 6: *Broadrick's occlusal plane analyzer*

Fig 7: *Diagnostic wax-up*

Fig 8: *Provisionalization*

Fig 9: *Final impression*

Fig 10: *Centric relation recorded*

Fig 11: *Surveying of wax patterns*

Fig 12: *Bisque trial*

Fig 13: *Final impression for implant retained partial overdenture*

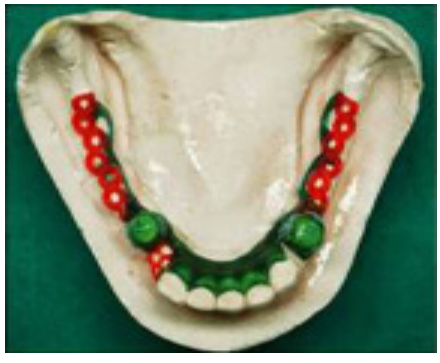


Fig 14: *Wax pattern on refractory cast*

Fig 15: *Framework on master cast*

Fig 16: *Framework trial*

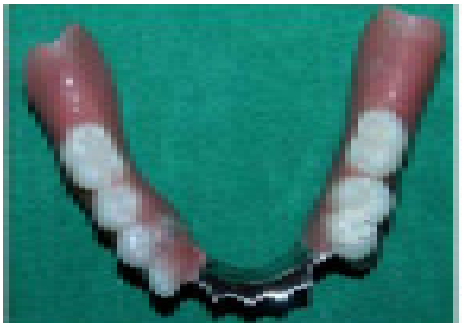
Fig 17: *Jaw relation recorded*

Fig 18: *Teeth arrangement*

Fig 19: *Bilateral balanced occlusion*

Fig 20: *Try-in*

Fig 21: *Bilateral balanced occlusion*



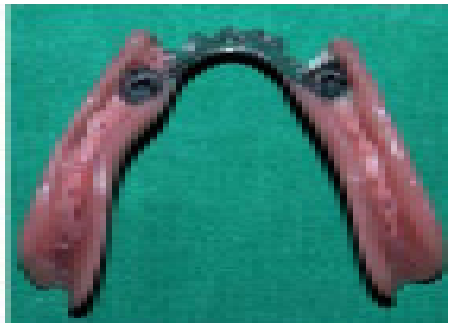


Fig 22: *Implant retained partial overdenture*

Fig 23: *Pick-up of patrix*

Fig 24: *Denture insertion*

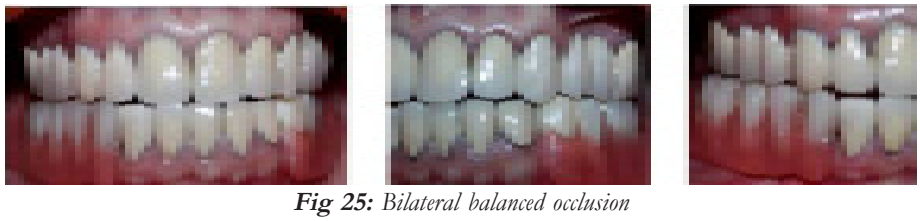


Fig 25: *Bilateral balanced occlusion*

Fig 26: *Occlusal view*

discussed with the patient and the definitive treatment plan was to perform a full mouth rehabilitation comprising of:

Maxillary arch –

- PFM crowns with 11 21;
- 4-unit PFM fixed dental prosthesis with 13 14 15 16 (pontic - 14 15) and
- 5-unit PFM fixed dental prosthesis with 22 23 24 25 26 (pontic - 24 25).

Mandibular arch –

- PFMcrowns - 31 32 33 41 42;
- Implant placement in 34 and 43 region with locator attachments and
- Implant retained partial overdenture (IRPOD) replacing 34 35 36 and 43 44 45 46.

Locator attachments were chosen for this case, as they are available in different vertical heights. They are resilient, durable, retentive and have some built-in angulation compensation.[1]

Clinical procedure

Rehabilitation of this case was planned in two phases- surgical phase and prosthetic phase.

Surgical phase:

To facilitate accurate implant placement, a partially limiting surgical guide was fabricated with clear auto-polymerizing acrylic resin (Fig. 4).[7] Access areas for predetermined implant sites were then drilled to provide guidance during the surgery. 2 endosseous implants (Myriad Connect Plus) measuring 3.8mm in diameter and 11mm in length were placed in 34 and 43 region of the mandible (Fig. 5). The healing abutments were secured over the implants and mucoperiosteal flap was sutured. Post-operative healing was uneventful.

Prosthetic phase:
The prosthetic phase was divided into 2 parts –

a. Restoration with fixed prosthesis and

b. Implant retained partial overdenture.

a. Restoration with fixed prosthesis:
The occlusal plane was established with Broadrick's occlusal plane analyzer (Fig. 6).[8] The diagnostic wax-up was made to establish incisal guidance (Fig. 7). After uneventful healing of surgical site, the tooth preparation of abutment teeth was performed. Provisional restorations were fabricated using the indirect technique (Fig. 8). The established incisal guidance and posterior occlusion was confirmed in provisional restoration. After the patient was comfortable with the provisional restorations, the impressions were made for definitive restorations. Gingival retraction was done and final impressions were made with polyvinyl siloxane (Speedex, Coltene, Switzerland) using 2-stage putty light body technique with spacer (Fig. 9). The impressions were poured in type-2 dental stone (Die stone, Ultrarock, India). Master cast with individual dies was fabricated.

Facebow record was made and transferred to the articulator. Centric relation was recorded and casts were mounted on semi-adjustable articulator (Fig. 10). The wax patterns for copings were fabricated. The mandibular wax patterns were surveyed; cingulum rests were incorporated for the metal framework for implant-retained cast partial overdenture (Fig. 11). Then coping trial was preformed and shade selection was done. The ceramic build up, bisque trial was done and shown to the patient (Fig. 12). After the patient's acceptance and confirmation of established incisal guidance; glazing of the fixed dental prosthesis was done and final cementation was carried out.

b. Implant retained partial overdenture:
After 4 months of uneventful healing, clinical and radiographic examination of the implants was carried out. After ensuring successful osseointegration of the implants, the fabrication of prosthesis was carried out as follows:

Impression procedure:
Implant-level closed tray technique was used for making an impression.[1] A special tray was fabricated with auto-polymerizing acrylic resin. Border moulding was performed to record the peripheral extensions. Then perforations were made in the tray and tray adhesive was applied. The healing abutments were removed and impression copings were placed. The impression was made with single-stage medium body polyvinyl siloxane impression material (Monophase, Aquasil, Dentsply, USA) (Fig. 13). The implant analogues were secured in the impression copings. Gingival mask (Gingitech, Ivoclar Vivadent, Liechtenstein) was poured around the analogues to simulate soft tissue. The impression was poured with type-2 dental stone (Die stone, Ultrarock, India).

The master cast was surveyed to analyze the path of insertion and plan the design for the framework. Then master cast was duplicated in reversible hydrocolloid impression material and refractory cast was poured. The wax patterns were contoured on the refractory cast for metal framework (Fig. 14). Then the patterns were sprued and the refractory cast along with patterns was invested. Casting was performed with cobalt-chromium alloy (Wirobond, Bego, USA). The casted framework was finished and polished. The metal framework fabricated for IRPOD was adjusted on the master cast (Fig. 15).

The metal framework was tried in the patient's mouth (Fig. 16) and its fit was evaluated by using pressure-indicating paste (Coltene PSI, Switzerland). After the complete seating of the framework was confirmed, the jaw relation was recorded (Fig. 17). The casts were mounted on semi-adjustable articulator. As the mandibular arch showed Kennedy's Class I situation, the planned scheme of occlusion was bilateral balanced occlusion.[9] Mandibular posterior teeth were arranged and bilateral balanced occlusion was achieved on the articulator (Fig. 18, 19). Then trial insertion of the denture was performed. The fit of the prosthesis, esthetics and phonetics was evaluated. The occlusion was checked for any premature contacts or interferences (Fig. 20). After balanced occlusion was confirmed intra-orally (Fig. 21), the denture was acrylized using injection-moulding technique.

The denture was then finished and polished (Fig. 22). The healing abutments were removed and the locator attachments were inserted. The block out rings were placed around the locator attachments to prevent material from flowing into the undercuts. Then the black processing caps were removed and the retentive inserts were picked up in auto-polymerizing acrylic resin (DPI, Mumbai, India). The pink retentive caps were used as they give moderate retention required for the denture (Fig. 23). The premature contacts and interferences were removed by selective grinding procedure. The planned occlusal scheme was confirmed after the denture insertion (Fig. 24, 25, 26). Post-insertion instructions about the use of the denture were given. The patient was educated and motivated to maintain good oral health with proper use of oral hygiene aids. Also, emphasis was given on regular follow-ups and recall visits.

Discussion
Attachment selection is often guided by the amount of inter-occlusal space available and should be evaluated at the diagnostic stage. The optimal distance measured between the crests of the ridge should be approximately24 ± 5 mm.[10]

Amongst all the different types of attachments available, the locator attachment has the smallest vertical profile available. It allows movements in both the vertical plane and the hinge axis.

It allows angulation correction of upto 20 degrees per implant (40 degrees for two divergent implants).[11] The alignment correction feature will facilitate a repeatable path of insertion. Retention is usually in the range of 1 to 5 pounds. Also, repair and replacement are quick and easy.[1]

In this case, metal framework was fabricated to provide rigidity to the prosthesis. The use of metal framework serves to prevent fracture of the overdenture. They offer the ability to detect thermal changes, which enhances the perception of ingested food and beverages - a positive attribute related to temperature transmission down to the mucosal tissues underneath.[10]

The planned occlusal scheme was bilateral balanced occlusion to avoid denture base displacement when occlusal loads are applied on the prosthesis.[9] In majority of cases, favorable distribution and redirection of the occlusal forces can be provided through cross-arch stabilization by the cast metal framework in combination with the use of resilient stud attachments.

The success of implants in the restoration of partial edentulism has been well documented in the literature.[12-14] Jemt et al documented cumulative success rates of 100% for mandibular overdentures and 77.9% for maxillary overdentures supported by two implants.[13] Mericske-Stern et al reported 97% implant survival with 2 implants (splinted or solitary), irrespective of duration of edentulism.[15]

The advantages of this type of prosthesis include:[1]

(1) The remaining teeth preserve the proprioception.

(2) Minimal number of implants are needed.

(3) Esthetically pleasing result – lack of clasp visibility and the provision of adequate lip support.

(4) Psychological advantage for patients who do not want to see themselves as totally edentulous.

(5) Preservation of alveolar bone by implants and remaining teeth.[16]

(6) Lower cost than implant supported fixed dental prosthesis and

(7) Easy to maintain oral hygiene.

Conclusion

This article discussed a newer approach in treating partially edentulous patients with implant-retained removable partial overdenture. The use of resilient attachments enhances retention significantly as compared to conventional prosthesis. The mandibular implant overdenture will drastically improve patient satisfaction, comfort and oral function. The follow-up is necessary for quality service and longevity of the prosthesis. This will aid in achieving great deal of satisfaction for both the patient as well as the clinician.

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Modified Camper's plane indicator: A device for adjusting the occlusal plane

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Abstract

Establishing the plane of occlusion in complete dentures is an important criteria for achieving esthetics and bilaterally balanced occlusion. Camper's line acts as a guide in adjusting the occlusal plane. This article mentions an instrument, which is simple, accurate & provides us to orient the occlusal plane. **(Terna J Dent Sci 2014;3(1):41-42)**

Key words: Camper's plane, occlusal plane, ala-tragus line, inter-pupillary line

Introduction

In fabrication of complete dentures, the occlusal plane is defined as "the surface of wax occlusal rims contoured to guide in the arrangement of denture teeth."[1] The occlusal plane is adjusted by fabricating the maxillary occlusion rim parallel with facial guides such as the interpupillary lines & Camper's line.

Peter Camper, anatomist, physician & surgeon is known to the dental profession for his description of "a horizontal line drawn through the lower part of the nose & the orifice of the ear", which later on in 1794 became to be known as "Camper's line". His work described a line passing through the anterior nasal spine and the center of the auditory meatus.[1]

Camper's plane[2] has been described as a plane made by the inferior border of both alae of nose & the superior aspect of the tragus of both the ears. It is also called as a Avanthion - External auditory meatus plane.

Conflict of interest and source of funding
The authors declare that there is no conflict of interest concerning the contents of the study.
This study has been self-supported by the authors.

Review of literature:

Kurt in 1940 wrote that Bromell discovered this plane relationship with the occlusal plane, & Snow popularized the concept. Snow fixed his bite-fork in the upper occlusion rim in such a way that the handle, when the rim was placed in the patient's mouth, was parallel with a plane extending from the bottom of the glenoid fossa & passing through anterior nasal spine. This plane cannot be determined directly on a living person; but it approximately corresponds with a line drawn from the upper part of tragus to the lower edge of nostril. In American literature, it is popular as the 'Bromell' plane, whereas in Europe it is called as Camper's plane. Gysi proposed the term "*prostetiche Ebene*" (the prosthetic plane) for the similar plane.[3] But somehow this plane has been popularly accepted as Camper's line.

Miller[4] suggested the use of a tongue blade or the blade of knife for establishment of the Camper's plane. Fox plane or occlusal plane indicator[5] has been accepted worldwide for this purpose. The device is placed along the maxillary occlusion rim, while the outer projections are made parallel anteriorly as well as posteriorly. Anterior parallelism is adjusted with the interpupillary line for the purpose of achieving esthetics. The anterior rim can also be made perpendicular to the long axis of face. Secondly, posterior parallelism is adjusted with that of the ala-tragus line for the purpose of esthetics & managing chewing efficiency of the prostheses.

Javid[6] used a J-shaped aluminum instrument called as "J-plane" along with the Fox plane for convenience.

Santana-Penin & Mora[7] advocated a U-shaped stainless steel device with shorter arm bearing 2 sliding rests placed on occlusal surface & other longer arm lies outside. The outer arm helped in evaluation of anteroposterior inclination of the occlusal plane (IOP) with respect to Camper's plane or Frankfurt plane. Husseinovitch & Chidiac[8] proposed a modified occlusal plane device prepared by fixing 2 freely moving rulers on 3 long screws.

Fig 1: *Camper's Plane Indicator*

Fig 2: *Assembly of the plates*

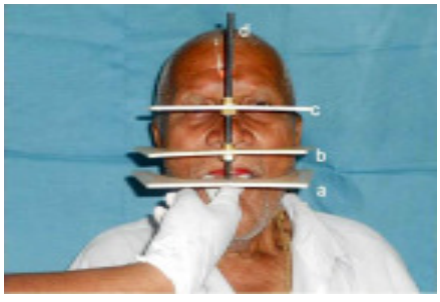

Fig 3: *Adjusting the middle plate along the Camper's plane & checking for parallelism between two lower plates*

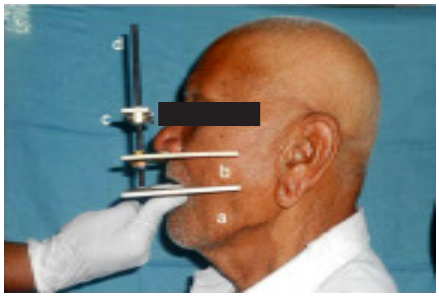

Fig 4: *Parallelism of occlusion rim with the inter-pupillary line*

Materials required

The Camper's Plane Indicator is prepared by three plastic Fox plane shaped properly, an aluminum rod 6 inches long & a brass fitting keyway. The lower plate is fixed with a lock-nut & the brass fitting keyways are placed on the middle & upper plate so that it can move freely in vertical direction along the aluminum rod. A small thumb screw is placed on the brass fitting keyway for holding the middle & upper plate along the Camper's plane (Fig. 1).

Procedure

All the three plates are assembled as seen in Fig. 2. Loosen the thumb screw on brass fitting and place the lower plate intraorally along the maxillary occlusal rim.

Adjust the middle plate along the Camper's plane & check for parallelism between two lower plates (Fig. 3). If the occlusal plane is not adjusted properly, the middle plate will not lie on ala-tragus line and so necessary adjustments are to be done until parallelism is achieved. The third & upper plate helps us to indicate the parallelism of occlusion rim with the inter-pupillary line (Fig. 4).

Discussion

The Modified Camper's plane indicator fabricated in this article is innovative in design to give immediate result. The instrument is simple, practical, inexpensive and could be easily made. The middle plate helps us for determining parallelism with ala-tragus line thus increases the masticatory efficiency of denture. The upper plate shows the parallelism with the inter-pupillary line and thus gives us esthetic improvement of dentures. The aluminium rod indicates the facial midline.

It does not require additional item such as plastic block, cardboard, tongue blade or ruler for estimation of occlusal plane. It is easy to perform & does not require help of any dental personnel or the patient to hold the instrument while the dentists checks the occlusal plane.[1]

Occlusal plane determination acts as a preliminary step in fabrication of complete dentures to provide stability & to decrease leverage forces. It also helps us to provide denture esthetics & increase of masticatory efficiency by anterior & posterior parallelism respectively.

Summary

The device is accurate & easy to use with every part assembled in one unit. This procedure also could be done single handedly. Occlusal plane could be modified by the parallelism between upper & middle plates. This device is also helpful in evaluating the facial midline & parallelism with inter-pupillary line.

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Treatment of a young adult skeletal class II case with fixed functional appliance – A case report

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Key words: Skeletal class II, Forsus, fixed functional appliance

Abstract

Traditionally the appliances used for correction of class II malocclusion included class II elastics, myofunctional appliances, headgears, etc. The main disadvantage with all these appliances is that they are removable and require patient compliance for its effectiveness. The other disadvantages of the removable appliances include 1) larger in size, 2) require lab procedures in some cases, 3) cause discomfort, 4) impinge on mucosa in case of some appliances, 5) cause difficulty in deglutition and speech, 6) reduce the oral cavity space and 7) very often even affect the aesthetic appearance. Forsus^{TM} is a hybrid fixed functional appliance which is composed of a telescoping spring that attaches at the upper first molar and a push rod linked to the lower archwire, distal to either the canine or first premolar bracket. It is used to reposition the mandible forward and has effects similar to traditional fixed functional appliances. Forsus is not as rigid as previous fixed functional appliances and hence comfortable to the patients comparatively (Fig. 1 & 2). Following is a case report of a patient who is at the end of the growth stage has mandibular retrognathia with Angles class II, division I subdivision on the left side. Intraorally patient has bimaxillary proclination with an overjet of about 7-8 mm. **(Terna J Dent Sci 2014;3(1):43-46)**

Introduction

Class II division I malocclusion presents a major challenge to orthodontists. Treatment of the adult class II patients requires careful diagnosis and treatment planning that takes into consideration esthetic, occlusal and functional aspects. The normal protocol for treatment of class II division I malocclusion in adults generally involves either orthognathic surgery or camouflage.[1]

Forsus is a hybrid fixed functional appliance. Being hybrid, it has advantages of both rigid and flexible fixed functional appliances. Like the rigid appliance, it provides optimal force required for the skeletal change. It allows free lateral movements of the mandible and is more comfortable to the patient like flexible functional appliances.[2,3] Fixed functional appliances facilitate the forward and downward displacement of the mandible. They also cause a posterosuperior displacement of the maxillary dentition and pterygoid plate and thus contribute to the correction of a Class II malocclusion. Mandibular incisor proclination is the most pronounced dentoalveolar side effect seen during fixed functional treatment.[4] This could be prevented by cinching the mandibular archwire and laceback in the mandibular arch and by incorporating progressive lingual crown torque in the mandibular anterior segment. Inclusion of the second molars during treatment could enhance anchorage and prevent unwanted proclination of anterior teeth (Vogt 2006). The purpose of this paper is to summarize and discuss about class II division II malocclusion and its treatment with forsus in an adult patient.[5,6]

Conflict of interest and source of funding
The authors declare that there is no conflict of interest concerning the contents of the study.
This study has been self-supported by the authors.

Case report

A 17 year old patient came with a chief complain of forwardly placed upper teeth. On examination, the patient had a convex profile with competent lips. She had a class II base skeletally with angles class II division I malocclusion with subdivision on left side dentally (Fig. 3 & 4). Cephalometrically the pre treatment records confirmed the Class II skeletal base with a ANB of 5^0 and SN-GoGn of 27^0. Other cephalometric readings include upper incisor to NA - 12mm/45^0, Lower incisor to NB - 8mm/30^0 and lower incisor to mandibular plane angle - 103^0 with an overjet of 8 mm. (Fig 5, 15 & 16).

Extraction of all the first premolars was carried out to correct bimaxillary proclination. Alignment was carried out using a 0.016 NiTi wire (Fig 6 & 7).

Canine retraction was done on a 17*25 S.S. wire along with anchor loss on left side so as to convert the molar relation to class II, this was done by making the arch wire round in the posterior section on the left side (Fig. 7). Progressively the archwire was

Fig 1: *Components of 3M forsus*

Fig 2: *Determination of spring size*

PRE-TREATMENT EXTRA-ORAL VIEW

Fig 3: *Pre-treatment, extra oral view*

PRE-TREATMENT INTRA-ORAL VIEW

Fig 4: *Pre-treatment, intra oral view*

PRE-TREATMENT XRAYS

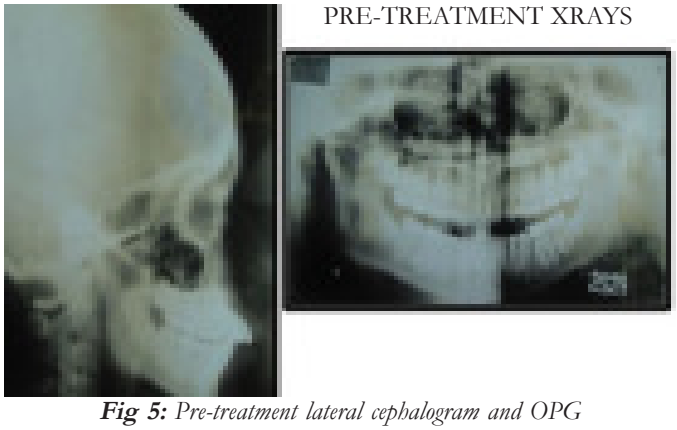

Fig 5: *Pre-treatment lateral cephalogram and OPG*

LEVELING AND ALIGNING EXTRA-ORAL

Fig 6: *Leveling and aligning, extra-oral*

AFTER 1ST MOLAR ANCHOR BURN ON LEFT SIDE INTRA-ORAL

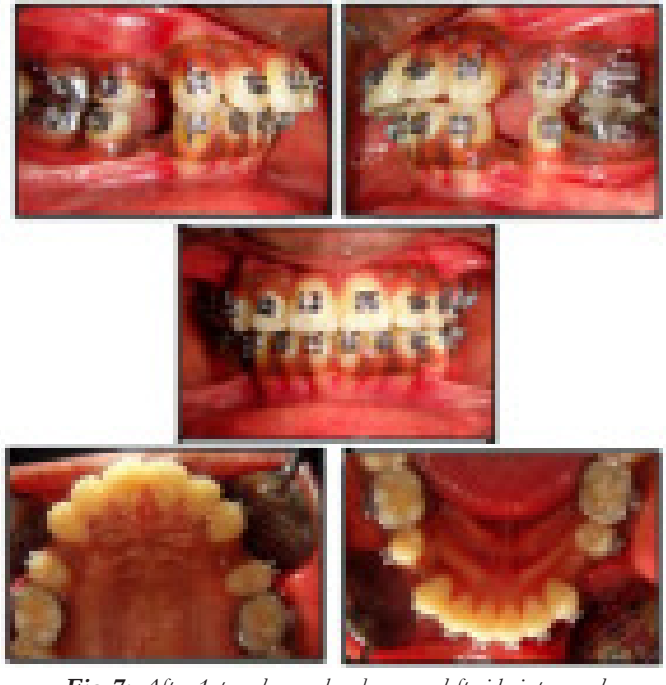

Fig 7: *After 1st molar anchor burn on left side intra oral*

PRE FORSUS EXTRA-ORAL

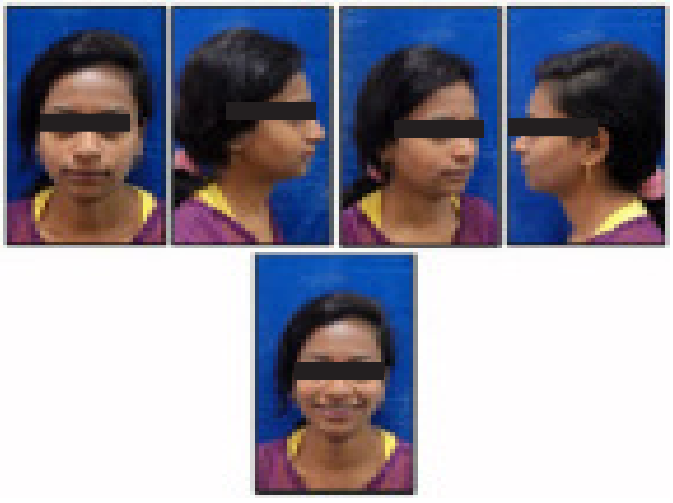

Fig 8: *After extraction space closure, extra oral*

PRE FORSUS INTRA-ORAL

Fig 9: *After space closure, intra oral*

PRE FORSUS CEPHALOGRAM AND OPG

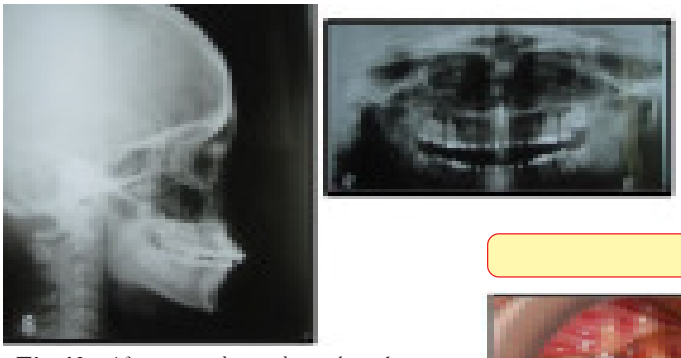

Fig 10: *After space closure lat.ceph and opg*

FORSUS

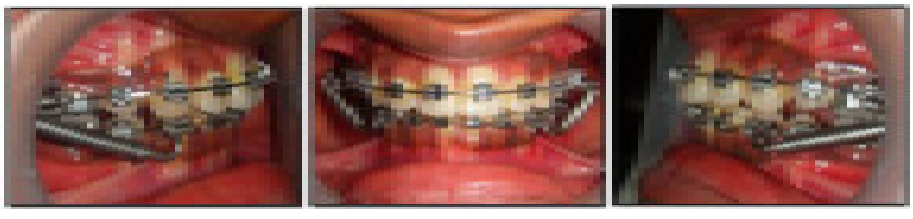

Fig 11: *After placement of forsus*

change to 19*25 S.S. and complete retraction was carried out in both the maxillary and mandibular arches. After complete retraction 21*25 HANT wire was inserted so as to avail the insertion of 21*25 S.S. wire. Before insertion of 21*25 S.S. wires, the anterior section was given a labial root torque in the lower arch so as to counteract the flaring out of the incisors. The wires were cinched so that the forces from the FRD was transmitted to the entire arch as a unit to prevent the spaces from opening up (Fig. 8 & 9). Pre Forsus™ cephalometric findings were: ANB - 4°, SN-GoGn - 23°, upper incisor to NA - 9mm/36°, lower incisor to NB - 5mm/25° and lower incisor to mandibular plane angle - 96° with an overjet of 6 mm (Fig. 10, 15 & 16).

With Forsus –

After 4 months of continuous wear of forsus, the molar and canine relationship was class I with the midlines coinciding. The soft tissue profile had improved from before (Fig. 11, 12, 13). The post forsus cephalometric finding showed ANB - 2°, Sn-GoGn - 24°, upper incisor to NA – 8mm/31°, lower incisor to NB – 7mm/25° and lower incisor to mandibular plane angle – 99° with an overjet of 2mm (Fig. 14,15 & 16).

Discussion

Alternate treatment option discussed in this patient was 1) camouflage with asymmetrical extraction pattern 2) orthognathic surgery with mandibular advancement. The patient refused the orthognathic surgery outright, while the camouflage and asymmetrical extraction would have reduced the nasolabial angle but the improvement in the profile would have still been inadequate in terms of lower half of the face.

The 3rd treatment option was extraction along with the jumping of the bite with forsus. This allowed us to remove the decompensations and also improve the position of the mandible resulting in a better profile. Keeping in mind the amount of residual growth left we decided to go for the third option.

Conclusion

The key for success in class II treatment is limiting the side effects, minimizing the need for patient compliance and avoiding appliance breakage. Forsus Fatigue Resistant device in the presented patient with residual growth brought about

PRESENT STAGE EXTRA-ORAL

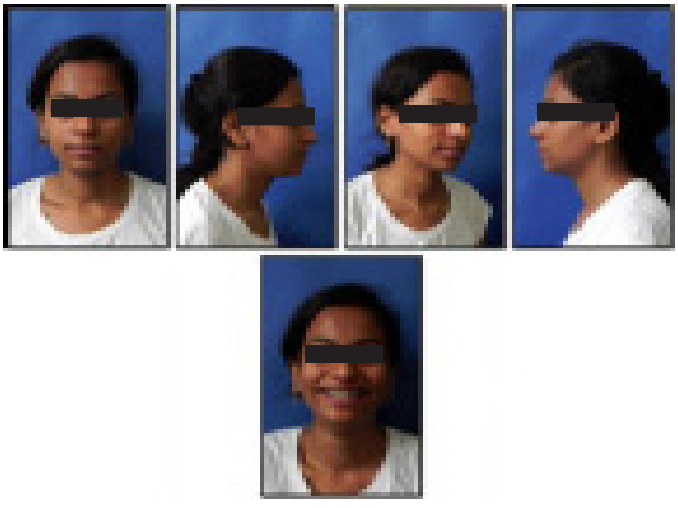

Fig 12: *After forsus, extra oral*

PRESENT STAGE INTRA-ORAL

Fig 13: *After forsus, intra oral*

PRESENT STAGE CEPHALOGRAM AND OPG

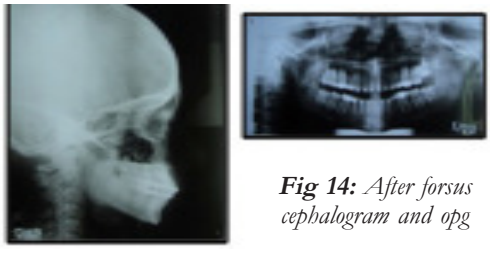

Fig 14: *After forsus cephalogram and opg*

VARIABLE	NORMAL	PRE TREATMENT	PRE FORSUS	PRESENT STAGE
Skeletal relationship				
Dental relationship				

Fig 15: *Comparitive cephalogram analysis at different stages*

VARIABLE	NORMAL	PRE TREATMENT	PRE FORSUS	PRESENT STAGE
Skeletal Analysis				

Fig 16: *Comparitive cephalogram analysis at different stages*

primarily dentoalveolar changes and mild skeletal changes in late adolescence phase. There was improvement in soft tissue profile of the patient as well as the occlusion.

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A Boon for Orthodontic Research: An overview of Finite Element Analysis

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Abstract

The finite element analysis is a significant research tool for biomechanical analyses in biological research. It is an ultimate method for modelling complex structures and analyzing their mechanical properties. The advantages of FEM such as, its repeatability, no ethical considerations and the fact that study designs may be modified and changed as per the requirement, makes it superior to other available methods. The purpose of this article is to give an insight of the finite element analysis which apart from its varied uses in dentistry has immense applications in the field of orthodontic research too. **(Terna J Dent Sci 2014;3(1):47-49)**

Key words: FEM, research, Orthodontics

Introduction

Finite Element Analysis (FEA) is a highly precise numerical method of analyzing stresses and deformations in structures. In order to achieve this goal, the structures are broken down into many small simple segments or elements, each with specific physical properties, thereby reducing the error in the solution. In the last few years, the application of Finite Element Method (FEM) has revolutionized dental biomedical research. Because of its ability to solve complex stress-strain problems related to mechanics using powerful computer-simulation tool, it has proved to be a boon in the field of Orthodontic research.

History

Its development can be traced back to the work of A.Hrennikoff and R.Courant in the early 1940s who utilized it to obtain approximate solutions to vibration systems. In early 1960s it was used to solve the problems of the aerospace industry. Since then its use has been extended to solve problems in heat transfer, fluid flow, mass transport electromagnetics, in medicine and other branches of health sciences. The term **'Finite Element'** was coined by Argyris and Clough in 1960.

Conflict of interest and source of funding
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Until 1970s, FEA was limited to expensive mainframe computers generally owned by the aeronautics, automotive, defence and nuclear industries. Since the rapid decline in the cost of computers and the phenomenal increase in computing power, FEA has been developed to an incredible precision. Nowadays it is possible to produce accurate results for a variety of parameters.

Why the need?

Studies examining the behaviour of oral structures require a complex investigation of the fundamentals of the stomatognathic system. Conventional methods have turned out to be inadequate to predict reliable stress distribution in the tooth and the adjacent regions that are required for such studies. Also, as in vivo measurement of stress is difficult at best; thus, development of an effective model is the need of the hour.

FEA can be done on both 2D and 3D models. 2D modelling programs work on the basis of the assumption that the same geometry exists in all sections parallel to the plane defined in the model. 3D mathematical models have the advantage of providing more detailed images, with the possibility of spatial rotation and the visualization of internal structures. Because of its ability to accurately assess the complex biomechanical behaviour of heterogeneous material in a non-destructive, repeatable manner; the use of FEM in research has gained immense popularity.

Today various analysis packages are available in the market; they are NASTRAN, CATIA, WACAN, NISA, IDEAS, ANSYS, ABACUS, PRO-E, etc.

The accuracy of the Finite Element Method depends on the discretization process, which is characterized by the finite element mesh and the choice of the element, type of element, shape of element, geometry of the system, refinement of the mesh, application of the load and skill of the software.

BASIC STEPS INVOLVED IN FEA WITH ANALYSIS SYSTEMS (ANSYS)

For a given structure/element/domain in numerical methods some of the steps should be followed. The steps to be followed are:

1. **Drawing geometric models**
   The first requirement for the analysis

is the designing of the geometrical model. It is generally done with the help of CT scans or Laser scans. After the scan, the model can be drafted or created either in analysis package itself or the model can be drafted/drawn in the CAD package and can be imported to the analysis package.

2. **Defining boundary condition and nature of problem**
The boundary condition here means that whether the domain/structure/components perform static function ie, act like a free-floating rigid body. The boundary condition is selected based on the type of analysis to be performed.

3. **Applying material properties**
In this step, the mechanical properties such as Young's modulus, Poisson's ratio etc, are defined to the components. This is done to feed the values for calculation of the solution. By using these values, the solutions are obtained.

4. **Applying element properties**
Now the domain/component are divided into number of elements. For this, the element properties have to be defined. First of all we have to define the type of element. There are several types of elements available to be implemented to the domain/components.

5. **Discretization process**
Discretization is a process of dividing the domain/component into number of elements. For this, an assumption is made that the elements are interconnected by nodes. The main idea behind discretization process is to improve the accuracy of the results. This is because if the entire components are divided into number of elements, then the stress distribution in each element will be nearer to the actual results and thereby we get an accurate plot of the stress distribution in a component.

6. **Applying constraints**
Before the application of load, the component/domain should be subjected to some constraints as mentioned before so that the body acts like a free floating rigid one.

7. **Application of load**
After the application of constraints, the discretization domain is subjected to known loads. The application of loads depends upon the geometry of the components. The load is applied either on to nodes, line or area.

8. **Solution**
The results can be obtained instantly and is more accurate. The values from finite element analysis are represented as maximum and minimum principal stresses or Von mesis maximal stress depending upon whether the material is ductile or brittle.

Application in Dentistry

The use of FEM in dental sciences was started in 1968 by Ledley and Huang when they developed a linear model of the tooth based on experimental data and on linear displacement force analysis. Since then it has been used for studying stress patterns of different human teeth in different clinical situations.

- It can also very accurately calculate the load bearing patterns of various designs of restorations, prosthesis and Orthodontic skeletal anchorage systems like mini implants and mini plates.
- FEA has been used to simulate the bone remodelling process, to study internal stresses in teeth and different dental materials.
- It is used to optimize the shape of complex restorations.
- It has its immense application in the field of oral implantology to estimate peri-implant stress and strain.

Application in Orthodontics

Orthodontic movement principally depends on stress and strain in periodontal ligament. Analysis of stresses produced in the periodontal ligament when subjected to orthodontic forces can be done with FEA. Hence it can be used as a tool for studying orthodontic tooth movement.

- It has been used to know the centre of resistance of various structures of the craniofacial complex and the effect of different force directions of the orthopedic appliances to the craniofacial complex.
- Finite element analysis has been applied to the description of form changes in biological structures particularly in the area of growth and development.
- It is also used to study structures with inherent material homogeneity and potentially complicated shapes such as micro implants and mini plates.
- It can also be used to study the biomechanics of orthodontic tooth movement.
- FEM can also be applied for prediction of face soft tissue deformations resulting from bone repositioning in maxillofacial surgery
- It is used to accurately assess the effect of new appliance systems and materials.
- Hence FEM proves to be an important tool in the development and improvement of orthodontic bracket and wires design and newer materials.

Advantages

- Once the model is designed, multiple load applications can be done promptly. Also, results are obtained immediately making the study without delay.
- The object of interest can be studied in 3-dimension.
- Actual stress experienced at any point can be measured accurately.
- It is non-invasive and atraumatic technique.
- The finite element model is the most suitable means of analysis because of its ability to handle various shapes and materials of non homogenous nature.

Table 1: Table showing material properties which are obtained from previous studies.

Materials	Young's modulus (N/mm^2)	Poisson's Ratio
Tooth	1.96×10^4	0.30
Periodontal ligament	0.667	0.45
Cortical Bone	1.37×10^4	0.26
Cancellous Bone	1.37×10^3	0.30

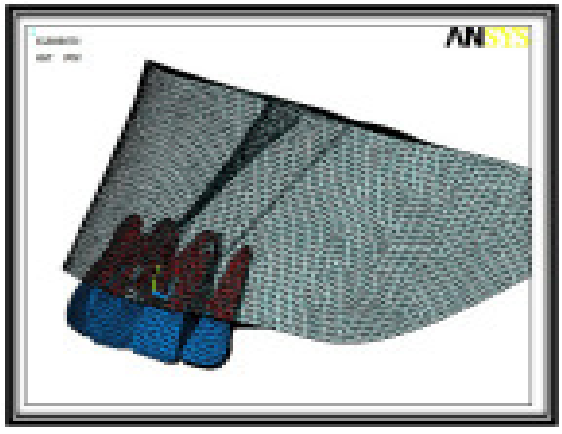

Fig 1: *FEM Model of maxillary incisors with alveolar bone*

- FEM provides the orthodontist with quantitative data that increases the understanding of the physiologic reactions that occur after force application and may yield an improved understanding of the reactions and interactions of individual tissues.

Shortcomings

- As with any theoretical model of a biologic system there are some limitations with FEM. The results of the finite element method analysis must be interpreted with great care. The accuracy of the analysis is dependent on the modelling of structures as closely as possible to the actual.
- A few assumptions are made in terms of the formulation, material characterization, nature of boundary conditions and the representations of loads which may affect the validity of the results.
- The success of the future finite element analysis will depend upon the detailed accuracy of the physical properties for the teeth and adjacent structures
- Accuracy of results is heavily dependent on the skill of the Software operator/analyst.
- Cost of the research increases as the analysis is expensive.

Conclusion

From the point of view of the numerous researches taking place in the field of dentistry in the recent times especially in the field of Orthodontics, finite element analysis has proved to be the most adaptable, accurate, easy and less time consuming process as compared to the other experimental analyses. It has provided Orthodontists with useful information to achieve a higher degree of success and patient satisfaction. Despite certain limitations out of which the most important is the cost factor and requirement of an expert to operate the analysis, this technique still is well ahead of the other available techniques in terms of accuracy and practicality. With further research in the field of FEA, it will surely become an indispensable tool in the Orthodontic armamentarium.

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Biocompatibility testing

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Abstract

Cytotoxicity is the ability to kill cells and is used to describe the cascade of molecular events that interfere with macromolecular synthesis, causing unequivocal cellular, functional and structural damage.[1] Cytotoxicity is the determinant of biocompatibility and biocompatibility is the ability of a restorative material to induce an appropriate and advantageous host response during its intended clinical usage.[2] **(Terna J Dent Sci 2014;3(1):50-51)**

Key words: Cytotoxicity, biocompatibility, dental materials

Introduction

Dental materials may result in damage to various tissues. Therefore, a great variety of different test methods are applied to evaluate the risk of such damage to ensure material compatibility prior to market launch. The common approach and principle when testing the biological behavior of materials is to start with simple in vitro tests mostly based on cell cultures. If these experiments and investigations of a material's efficiency deliver promising findings, then more comprehensive studies on experimental animals and usage tests (in vivo evaluation) are performed. Clinical studies are the final step of this evaluation process.

Autian (1970) was the first to propose a structured approach as a concept consisting of three levels:

1. Nonspecific toxicity (cell cultures)
2. Specific toxicity (usage tests, eg. In subhuman primates)
3. Clinical testing in humans

Conflict of interest and source of funding

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In 1984, the following sequence was adopted

1. Initial tests (cytotoxicity, mutagenicity, cell cultures)
2. Secondary tests (sensitization, implantation tests)
3. Usage test

Cell cultures

Many claims about the biocompatibility of products made by manufacturers are based on data from cell culture studies. Isolated cells derived from animal or human tissues are grown in culture plates and then are used for these tests.[3,4] Mostly, permanently growing cells (permanent cell lines) are used for this purpose because these cells can be easily amplified and their behavior is well known, relativelyconsistent, and constant. Frequently, permanent mouse fibroblasts (L-929, 3T3) or human epithelial cells (HeLa) are used. However, other cells directly grown from explants (biopsies) of target tissues are applied too, like gingival or pulp fibroblasts. These cell cultures are treated ("incubated") with the materials or their extracts. Subsequently, a series of various parameters will be measured, for example, the number of "surviving" cells, protein synthesis, enzyme activity, or synthesis of inflammatory mediators.5 One of the first methods for the evaluation of cell damage due to materials was based on the dye "neutral red". This dye stains vital cells, whereas cells with membrane damage will not be stained. Another method, which is often applied today, is to determine the activity of mitochondrial enzymes photometrically via a color change reaction (MTT assay).

Implantation Tests

For implantation tests, materials are implanted subcutaneously, intra-muscularly, or in the bone of an experimental animal (rats, rabbits, etc.). After different periods of implantation of the material in the tissues (between 1 week and several months), the adjacent tissue is investigated macroscopically and microscopically. After a short implantation time (1–2 weeks), degrees of inflammation surrounding the implant will primarily be assessed. In the case of an extended implantation period, the nature and quantity of the connective encapsulation will be evaluated, too.[5]

In contrast to cell culture tests, implantation studies also provide information about the removal of toxic substances from the tissue (open system) and about the defense reaction of the entire organism, such as via an inflammatory reaction. Thus, this type of study is closer to the patients than cell culture experiments are. However, a good

correlation was found between cell culture data and findings from implantation tests regarding certain dental filling materials.[6] For instance, ZOE provokes a pronounced tissue reaction in implantation tests, as it does in cell culture experiments. When testing alloys by means of implantation, an extended implantation period of tissue contact of more than 4 weeks is necessary.

Usage Tests

Can be of two types

1. Mucosa Usage Tests
2. Periapical Tissue Damage and Endodontic Usage Test

Mucosa Usage Tests

Various cell cultures and animal models have been described in the literature for testing mucosal compatibility (oral mucosa test).[7] A relatively new model consists of in vitro grown skin equivalents. For instance, in vitro co-cultures are grown that consist of skin fibroblasts and keratinocytes.[8] Partially or completely differentiated, multilayered, epithelial-like cells are being used in other models, and a number of new skin/mucosa models are currently being developed.[9]

Because of their technical limitations, oral mucosa tests are not considered in most national and international standards, so the number of relevant publications is comparatively small. Alternatively, other test methods (cell cultures, implantation tests) can be used to determine potential damage of the mucosa. Based on the experience of the cosmetics industry, in vitro grown mucosa equivalents may offer an interesting perspective, but experiences with dental materials are still minor.

Periapical Tissue Damage and Endodontic Usage Test

The literature includes descriptions of animal models (e.g., primates, dogs) that allow the application of a given material into the root canal according to endodontic techniques after a usual root canal preparation.Compatibility is assessed by histologic evaluation of the periapical tissues. It is also possible to induce pulp gangrene as a disease model in the experimental animal and to perform an appropriate treatment.[10] The classic endodontic usage test is very elaborate and includes the same technical and ethical problems as the pulp/dentin test using large experimental animals. Relatively few studies using this test method are available in the literature. The presented findings, however, document a good correlation with clinical observations. In particular, stimulating effects on special cells can be determined, such as the influence of calcium hydroxide compounds on periapical cementoblasts.[11] Otherwise, implantation tests, in which Teflon tubes are filled with the experimental material and subsequently implanted, may be used as alternatives.

Conclusion

The biocompatibility of dental materials can be only characterized based on different test methods. Statements about biocompatibility based on one test method only, have to be assessed very critically. Cell culture data are frequently used for advertising statements, since these tests can be quickly performed and they are cost-effective. But extrapolation of such findings to the patients is often questionable. Usage tests (e.g., pulp/dentin test) and allergy tests on experimental animals generate results that better represent the clinical situation. However, even these tests have certain limitations, and they always have to be evaluated together with the results from in vitro and clinical tests.

Clinical studies are decisive for the final assessment of a material and should always be requested from the manufacturer. However, regarding the biocompatibility there may be problems, since some damages, e.g., of the pulp, may occur without clinical symptoms. Therefore, clinical studies always need to be evaluated together with pre-clinical tests.

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Oral Lichen Planus – A review

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Abstract

Oral lichen planus (OLP) is a chronic mucosal condition commonly encountered in clinical dental practice. OLP affects 0.5-1% of the world population and 1.5% among Indians. It is a common disorder in which auto-cytotoxic T lymphocytes trigger apoptosis of epithelial cells leading to chronic inflammation. The skin lesions of lichen planus have been classically described as purple, pruritic, polygonal papules. These usually affect the flexor surfaces of the extremities. OLP can be a source of severe morbidity and has a small potential to be malignant. It is treated with anti-inflammatory agents, mainly the topical corticosteroids, but newer agents and techniques are becoming available. **(Terna J Dent Sci 2014;3(1):52-54)**

Key words: Oral lichen planus, immunopathogenesis, treatment

Introduction

Oral lichen planus (OLP) is a common mucocutaneous disease which was first described by Wilson in 1869.[1] Lichens are primitive plants composed of symbiotic algae and fungi and the term planus in latin means "flat". Wilson probably thought that the skin lesions looked similar enough to lichens growing on rocks to merit this designation.[2] The condition can affect either the skin, mucosa or both. It can cause bilateral white striations, papules and plaques on the buccal mucosa, tongue and gingiva.[1] It is seen worldwide, mostly in the fifth to sixth decades of life, and is twice as common in women than in men.[3] The diagnosis of OLP can be made from the clinical features if they are sufficiently characteristic, particularly if typical skin or other lesions are present, but biopsy is recommended to confirm the diagnosis and to exclude dysplasia and malignancy.[4]

Etiology (etiopathogenesis) Fig 1

OLP is a T cell-mediated autoimmune disease but its cause is unknown in most cases.[5] The increased production of cytokines is a key and early event in lichen planus (LP), it is genetically induced and genetic polymorphism of cytokines seems to govern whether lesions develop in the mouth alone (interferon-gamma (IFN-) associated) or in the mouth and skin (tumour necrosis factor-alpha (TNF-) associated). These migrated CD8+ T cells are activated directly by antigen binding to major histocompatibility complex (MHC)-1 on keratinocyte or through activated CD4+ lymphocytes. In addition, the number of Langerhan cells in OLP lesions is increased along with upregulation of MHC-II expression; subsequent antigen presentation to CD4+ cells and Interleukin (IL)-12 activates CD4 + T helper cells which activate CD8+ T cells through receptor interaction, interferon ã (INF - ã) and IL-2. The activated CD8+ T cells in turn kill the basal keratinocytes through tumor necrosis factor (TNF)-á, Fas-FasL mediated or granzyme B activated apoptosis.[8]

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Clinical Presentation

LP affects primarily middle-aged adults, and the prevalence is greater among women. Children are only rarely affected.[9] The classic skin lesions of the cutaneous form of LP can be described as purplish, polygonal, planar, pruritic papules and plaques. These skin lesions commonly involve the ûexor surfaces of the legs and arms, especially the wrists. The nail beds may also be affected, with resultant ridging, thinning and subungual hyperkeratosis.[10] Scalp involvement, if untreated, can lead to scarring and permanent hair loss. Since 30% to 50% of patients with oral lesions also have cutaneous lesions, the presence of these characteristic cutaneous lesions can aid in the diagnosis of OLP.[11] Several types of OLP have been described, the 2 main types being reticular and erosive OLP. It is not uncommon for the same patient to present with multiple forms of OLP.[11]

Reticular OLP: The reticular form is the most common type of OLP. It presents as interlacing white keratotic lines (known as Wickham's striae) with an erythematous border (Fig. 2). The striae are typically located bilaterally on the buccal mucosa, mucobuccal fold, gingiva and, less commonly, the tongue, palate and lips. A variant of reticular OLP is the plaque-like form, which clinically resembles leukoplakia but which has a multifocal distribution. These plaque-like lesions can range in presentation from smooth, ûat areas to irregular, elevated areas. This variant is commonly found on the dorsum of the tongue and on the buccal mucosa. Both the reticular form and its plaque-like variant are usually asymptomatic.

Erosive OLP: It is the second most common type. It presents as a mix of erythematous and ulcerated areas surrounded by ûnely radiating keratotic striae. When erosive OLP involves the attached gingival tissue, it is called desquamative gingivitis. The lesions of erosive OLP migrate over time and tend to be multifocal. Patients with this form of OLP often present with symptoms ranging from episodic pain to severe discomfort that can interfere with normal masticatory function. Two additional presentations are the atrophic and bullous forms, which are considered variants of the erosive type. Atrophic OLP appears as diffuse, erythematous patches surrounded by ûne white striae. This form can cause signiûcant

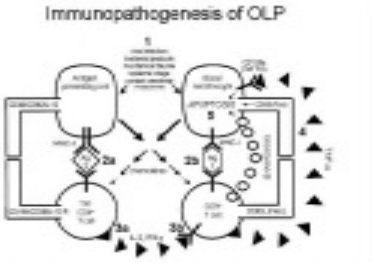

Fig. 1: *The pathogenesis of oral lichen planus has been illustrated with schematic representation. (Courtesy- Sugarman PB, Savage NW, Walsh LJ, Zhao ZZ, Keran A,Seymour GJ, Bigby M. the pathogenesis of oral lichen palnus. Crit Rev Oral Biol Med. 2002;13(4):350-365.)*

Fig. 2: *The interlacing white lines are typical of reticular lichen planus involving the posterior buccal mucosa, the most common site of oral involvement.*

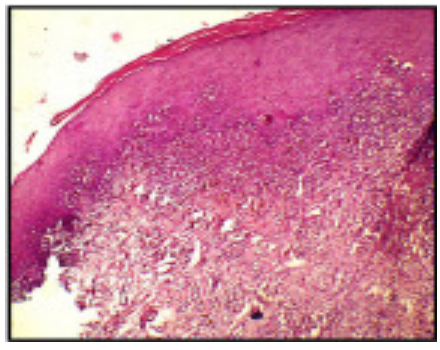

Fig. 3: *Low-power photomicrograph of an oral lesion shows hyperkeratosis, saw-toothed rete ridges and a band-like infiltrate of lymphocytes immediately subjacent to the epithelium.*

discomfort. In the bullous form, intraoral bullae are present on the buccal mucosa and the lateral borders of the tongue; the bullae rupture soon after they appear, which results in the classic appearance of erosive OLP.[11]

Histopathology

The microscopic criteria for lichen planus include hyperkeratosis, basal layer vacuolization with apoptotic keratinocytes, and a lymphophagocytic infiltrate at the epithelium connective tissue interface. With time, the epithelium undergoes gradual remodelling.[12] The thickness of the spinous layer can also vary. The rete ridges may be absent or hyperplastic, but they classically have a pointed or "saw toothed" shape (Fig. 3).[2] Within the epithelium are increased numbers of Langerhans cells (as demonstrated with immunohisto-chemistry), presumably processing and presenting antigens to the subjacent T lymphocytes. Discrete eosinophilic ovoid bodies representing the apoptotic keratinocytes are noted at the basal zone. These colloid,[12] cytoid,[2] hyaline[2] or civatte, bodies are seen in other conditions such as drug reactions, contact hypersensitivity, lupus erythematosus, and some non-specific inflammatory reactions. Direct immune-fluorescence demonstrates the presence of fibrinogen in the basement membrane zone in 90% to 100% of cases[12] as a shaggy band.[2] Although immuno-globulins and complement factors may be found as well, they are far less common than fibrinogen deposits.[12]

Differential Diagnosis

Other diseases with a multifocal bilateral presentation that should be included in a clinical differential diagnosis are lichenoid drug reaction, lupus erythematosus, white sponge nevus, hairy leukoplakia, cheek chewing, graft-versus-host disease, and candidiasis.[12] Lichenoid drug reactions are usually unilateral in distribution, accompanied by a history of new drug intake. The most reliable method to diagnose lichenoid drug reactions is to note if the reaction resolves after the offending drug is withdrawn, and returns if the patient is challenged again.[8] Idiopathic leukoplakia and squamous cell carcinoma might be considered when lesions are plaque-like. Erosive or atrophic lichen planus affecting the attached gingiva must be differentiated from cicatricial pemphigoid, pemphigus vulgaris, chronic lupus erythematosus, contact hyper sensitivity, and chronic candidiasis.[12]

Malignant Transformation

Malignant transformation of OLP is still controversial;[13] accumulation of inducible nitric oxide synthase (iNOS) with 8-nitroguanine and 8-oxo-7,8-dihydro-2'-deoxyguanosine (8-oxodG) in oral epithelium in OLP may reflect nitrative and oxidative damage to DNA that could be the basis of malignancy.[5] One review reports malignant transformation rates between 0% and 5.6%. The controversy is due to lack of uniform clinical and histological criteria for OLP and oral lichenoid lesions (OLL). The latter have also been termed interface mucositis or lichenoid mucositis. Oral lichenoid lesions have been considered by some to represent the lesion at risk if associated with dysplasia. In a recent study it was shown that all cases of malignant transformation (1.7%) involved cases of OLL and not OLP. Similarly, a study investigating whether OLP without dysplasia is premalignant by using microsatellite analysis for loss of heterozygosity (chromosomes 3p, 9p, 17p) did not support OLP as a lesion at risk. However, until distinct clinical and histological criteria have been developed on how to differentiate OLP from OLL, both lesions have to be considered as 'at risk for malignant transformation'.[13] Krutchkoff

Corticosteroids	Retinoids			Immuno-suppresive agents	Others
Topical	Systemic	Topical	Systemic		
Betamethasone phosphate	Prednisone	Fenretinide	Acitretin	Azathioprine	Amphotericin A
Betamethasone valerate	Methyl-prednisolone	Isotretinoin	Etretinate	Cyclosporin	Basiliximab
Clobetasol propionate			Isotretinoin		Diethyldithio-carbamate
Fluocinolone acetonide					Dapsone

and Vander Meij have proposed strict histopathological and/or clinicopathological diagnostic criteria which should be able to identify, within the large group of lichenoid lesions, those with and those without malignant potential. Nevertheless these criteria have not been validated.[14]

Management

Although OLP is often asymptomatic, patients with symptomatic OLP often require therapy and should be treated if symptoms are significant.[15] As OLP is a chronic disease, the patient's medical history, psychological state, and treatment compliance, as well as possible drug interaction, must be considered when evaluating the cost effectiveness of any treatment modalities.[16]

When oral lichenoid lesions are suspected to be related to the use of a given drug,[17] the medication should be discontinued whenever possible. Plaque and calculus deposits are associated with a significantly higher incidence of erythematous and erosive gingival OLP lesions,[18] whereas good oral hygiene is essential and can enhance healing.[19,20] Mechanical trauma of dental procedures, friction from sharp cusps, rough dental restorations, and poorly fitting dental prostheses can be exacerbating factors of symptomatic OLP and should receive attention. Furthermore, dental amalgam restorations can cause oral lichenoid lesions which may improve following replacement of amalgam with other restorative materials.[21,22] The psychological profile of the OLP patient should also be taken into account. Studies have reported higher levels of anxiety, greater depression, and increased psychic disorders in OLP compared with a control group and stress is one of the most frequent causes of acute exacerbations in OLP patients. Hence Pshycho-therapy is also advocated in OLP Patients.[23]

Various treatment regimens (Table I) have been designed to improve management of symptomatic OLP, but a permanent cure is not yet possible (modified from Carrozzo and Gandolfo).[23]

Conclusion

Patients with OLP should be counselled as to the nature of this chronic condition and the different approaches to treatment. Patients should be informed that they may experience alternating periods of symptomatic remission and exacerbation. Clinicians should maintain a high index of suspicion for all intraoral areas that appear unusual, even in patients with a histologically conûrmed diagnosis of OLP. This vigilance is especially important for isolated lesions occurring in locations at higher risk for the development of squamous cell carcinoma, such as the lateral and ventral surfaces of the tongue and the ûoor of the mouth.[11]

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Association between anemia and chronic periodontitis - A cross sectional study

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Key words: Anemia of chronic disease, chronic periodontitis, cytokines, hemoglobin, red cell indices

Abstract

Background: Periodontal medicine has thrown light on the increasing association between periodontal disease and systemic conditions. Anemia is one of the most common global public health problems in developing countries. The aim of the present study is to determine the association between hematological parameters and chronic periodontitis.

Method: A total of 60 systemically healthy subjects in the age group of 20-45 years, were selected for the study and categorized into two groups – Group A: subjects with chronic generalized periodontitis (test group) and Group B: subjects with clinically healthy gingiva (control group). Hematological parameters like hemoglobin (Hb), packed cell volume (PCV) and red cell indices [Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), and Mean corpuscular hemoglobin concentration (MCHC)] were recorded for both the groups.

Results: The mean values of haemoglobin (Hb), packed cell volume (PCV) and red blood cell indices (MCV, MCH and MCHC) were lower in test group as compared to control group. The mean values for Hb, MCV and MCH were significantly lower in test group, suggesting anemia.

Conclusion: A positive relationship was observed between the haematological parameters and chronic periodontal disease, suggesting that like other chronic conditions, periodontitis, may lead to anemia.

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Introduction

Anemia is one of the most common public health problems in developing countries. India is a country with very high prevalence of anemia in the world. Iron deficiency is the most common cause for anemia because of poor nutrition and high incidence of tropical and intestinal infections. Anemia of chronic disease is the second most prevalent anemia, associated with chronic infections or inflammatory conditions.

ACD is defined as the anemia occurring in chronic infections, inflammatory conditions or neoplastic disorders that is not due to marrow deficiencies or other diseases, and occurring despite the presence of adequate iron stores and vitamins.[1] A characteristic finding of the disorders associated with the ACD was the increased production of cytokines that mediate the immune or inflammatory response; such as tumor necrosis factor, interleukin-1 and interferon.[2] All the processes involved in the development of ACD can be attributed to these cytokines, including shortened red cell survival, diminished erythropoietin response to anemia, impaired erythroid colony formation in response to erythropoietin and the abnormal mobilization of reticuloendothelial iron stores. These cytokines are also released by periodontal tissues in response to bacterial infection, which suggests that periodontitis may cause ACD.

Periodontitis is a chronic infectious condition of the tooth supporting structures, and is caused by the subgingival colonization of predominantly gram-negative pathogens in a susceptible host. Perpetuation of the host response due to persistent bacterial challenge results in the release of pro-inflammatory cytokines. Bacteraemia has been observed in patients with periodontitis and has been directly related to the severity of inflammation of the periodontal tissues.[3] Studies have associated periodontitis with atherosclerosis, cardiovascular diseases and stroke. These studies indicate that periodontitis leads to a low-grade systemic inflammation.[4] Periodontal diseases are one of the more prevalent oral diseases affecting more than 50% of Indian community.

The association of anemia and periodontitis has been explored since the early 20th century. Earlier reports have suggested anemia to be a cause, and not a consequence, of destructive periodontitis. Lainson was one of the first authors to implicate anemia as a systemic cause of periodontitis.[5] Anemia is an important factor in the etiology or pathogenesis of

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periodontal disease.[6] A decrease in the number of erythrocytes apparently secondary to the presence of periodontal disease was reported.[7] In a study, the blood parameters were evaluated in patients with chronic periodontitis and the authors concluded that these patients show signs of anemia.[8] However, conflicting results have been reported regarding the association of periodontal disease and anemia.

Since, prevalence of both anemia and chronic periodontitis is high in indian population, the purpose of the present study was to compare the haematological parameters: hemoglobin (Hb) and red cell indices (MCV, MCH, MCHC) in patients with chronic periodontitis with that of periodontally healthy subjects, and thereby evaluating the possible association between chronic periodontitis and anemia.

Materials and Methods

Subject Selection

The study design was approved by the Institutional Ethical Committee. The study population consisted of 60 systemically healthy, non-smoking subjects within the age group of 20-45 years visiting the Department of Periodontology, Terna Dental College. The study subjects were categorized into 2 groups: Group A (Test group) included 30 subjects (15 females and 15 males) with chronic periodontitis (Fig. 1) and Group B (Control group) included 30 subjects (15 females and 15 males) periodontally healthy subjects (Fig. 2).

The inclusion criteria were 1) presence of at least 20 teeth 2) no history of antibiotic intake for 3 months prior and during the course of the study 3) no history of any minor or major trauma, any oral or general surgical procedure, which could have resulted in blood loss, 4) no history of any periodontal treatment at least 6 months before the commencement of the study, 5) no history of blood transfusion and/or donation for minimum of 3 months prior to the study, 6) no history of use of vitamin or iron supplements within the previous 3 months.

The selected subjects were verbally informed about the study protocol and a written consent was taken. A full mouth periodontal examination was conducted for all the subjects using following clinical parameters –

- Plaque Index – Silness and Löe, 1967
- Gingival Index - Löe and Silness, 1963
- Probing Pocket Depth – using William's Periodontal Probe
- Clinical Attachment Level (only for Group A) - using William's Periodontal Probe

Collection of Blood Sample

After full mouth periodontal examination, 5 ml of venous blood was obtained under aseptic conditions, from the ante cubital fossa. The blood samples were collected in EDTA containing vacutainers to be transported to the Pathology Laboratory for analysis. The estimation of the following hematological parameters was done: Hemoglobin level (Hb), Packed Cell Volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC).

Statistical Analysis

The data obtained was compiled and analyzed using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 17 for windows). Mean and Standard deviation for all parameters were calculated. The statistical significance of differences in independent variables for the intergroup measurements were tested according to Student t test (two tailed, independent). A two tailed Probability value $P < 0.05$ was considered as significant.

Results

The study population consisted of 15 males and 15 females with a mean age of 35.40±6.79 years and 39.87±4.50 years respectively for Group A, and a mean age of 38.20±5.78 years and 31.53±4.47 years for Group B.

Average probing pocket depth (PPD) for test group was 6.7 mm and average loss of clinical attachment level for test group was 4 mm.

The mean value of MCV and MCH were below reference range in the test group. When comparing group statistics, the mean value of hemoglobin, PCV, MCV, MCH and MCHC for Group A (Test) were lower as compared to Group B (Control), but mean MCV and mean MCH were significantly lower in chronic periodontitis (Test) group (80.80±7.75 and 26.75±3.49, respectively) than in controls (87.86±4.32 and 29.55±1.52, respectively) (P <0.05) (Table 1).

Table 1: Mean ± standard deviation and student's t-test significance values for hematologic parameters for test and control groups.

Parameters Test	Group A Control	Group B	Reference Value	P - value
Hb	12.82±1.96	13.74±1.51	11.50 -16.50 gm/dl	0.017
PCV	38.83±5.47	40.85±4.15	36-47 %	0.114
MCV	80.80±7.75	87.86±4.32	85-100 fL	0.000*
MCH	26.75±3.49	29.55±1.52	27-32 pg	0.000*
MCHC	33.02±1.90	33.65±0.70	28.5-34.5 g/dl	0.095
*P value=0.05 (significant at P<0.05)				
(Hb – Hemoglobin, PCV – Packed Cell Volume, MCV - Mean Corpuscular Volume, MCH – Mean Corpuscular Hemoglobin, MCHC – Mean Corpuscular Hemoglobin Concentration)				

The mean value of hemoglobin (Hb) in males was 14.26±1.28 in Group A (test) as compared to 14.74±1.42 in Group B (control), whereas in females, the mean value of Hb was 11.37±1.37 in Group A (test) as compared to 12.73±0.75 in Group B (control). The difference in mean hemoglobin between test and control groups in females was statistically significant ($p<0.05$) but it was not significant in males ($P >0.05$). Similarly, the difference in mean packed cell volume (PCV) in females was significantly lower in Group A (34.64±3.37) as compared to Group B (37.99±1.97).

Fig. 1: *Representative subject of Test group (Chronic Periodontitis)*

Fig. 2: *Representative subject of Control group (Periodontally healthy)*

The mean value of Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) were lower in Group A (males: 79.81±4.06, 26.50±2.36 and 33.17±1.68, females: 81.79±10.29, 26.99±4.42 and 32.87±2.14, respectively) as compared to Group B (males: 88.41±2.88, 29.86±0.94 and 33.78±0.71 females: 87.31±5.45, 29.25±1.92 and 33.51±0.68 respectively). Statistically significant difference was observed with respect to mean MCV and MCH in males and it was not significant in females. The difference in mean MCHC was also not significant in males and females (Table 2).

The results of the study indicate that test group i.e., subjects with chronic periodontitis showed significantly lower values of hemoglobin when compared to control, suggesting that periodontitis needs to be considered as a chronic disease which may cause lower number of erythrocytes and consequently lower hemoglobin levels. In our study, the values of PCV, MCV, MCH and MCHC in test group were also lower than control group, with statistically significant lower values of MCV and MCH. Red blood cell morphology was normocytic and normochromic for all subjects, indicating normocytic anemia, as commonly seen in Anemia of chronic disease (ACD) as compared to hypochromia, is commonly suggestive of iron deficiency anemia. Hence, this cross sectional study showed that a reduction of hematological parameters were associated with chronic periodontitis.

TABLE-2: Mean ± standard deviation and student's t-test significance values for hematologic parameters of males and females in test and control groups

Parameters	Males Group A	Females Group B		Group A	Group B	
Test	Control	P - value	Test	Control	P – value	
Hb	14.26±1.28	14.74±1.42	0.340	11.37±1.37	12.73±0.75	0.002*
PCV	43.03±3.61	43.71±3.78	0.615	34.64±3.37	37.99±1.97	0.003*
MCV	79.81±4.06	88.41±2.88	0.000*	81.79±10.29	87.31±5.45	0.077
MCH	26.50±2.36	29.86±0.94	0.000*	26.99±4.42	29.25±1.92	0.081
MCHC	33.17±1.68	33.78±0.71	0.210	32.87±2.14	33.51±0.68	0.274

**P* value=0.05 (significant at *P*<0.05)

(Hb – Hemoglobin, PCV – Packed Cell Volume, MCV - Mean Corpuscular Volume, MCH – Mean Corpuscular Hemoglobin, MCHC – Mean Corpuscular Hemoglobin Concentration)

Discussion

In the present study, a total of 60 subjects [30 chronic periodontitis (Test) and 30 healthy (Control)] were enrolled. Both test and control groups were sex matched. Both the sexes were considered for inclusion because both were prone for anemia.[8]

Tobacco smokers and chewers were excluded from present study because it is one of the confounding factors. Smoking affects the immune system and microflora of the patient leading to deeper probing depths, greater clinical attachment and bone loss. Smoking also affects erythrocytes and other blood parameters. According to a previous study, smokers with chronic periodontitis had lower number of erythrocytes, a lower value of hemoglobin, and lower hematocrit and iron compared to non-smokers with chronic periodontitis.[9]

In India, anemia is more prevalent in females because of the lack of proper nutrition, increased menstrual losses, high incidence of tropical and intestinal infections and other miscellaneous factors.[10] Females are also prone to hormonal imbalance during puberty, during the reproductive phase, and towards menopause. The microbial flora and host immune response are altered leading to exaggerated response of the periodontal tissues to local factors. Therefore, to eliminate bias, equal number of males and females were included in the test as well as control group in our study. Sex of subjects was found to be significant covariates for all clinical and RBC parameters, so all clinical and RBC analyses were carried out separately for both sexes. In the test and control groups, statistically significant difference was observed amongst males in MCV and MCH levels as compared to females, whereas in females Hb and PCV levels were significantly lower as compared to males.

The possible mechanisms involved in the association between the progression of periodontal disease and the reduction in the number of erythrocytes are as follows.

1) Periodontal inflammation might affect erythropoiesis. The downregulation of the erythropoiesis in bone marrow by pro-inflammatory cytokines such as interleukin (IL) 1, 6 and tumor necrosis factor-á could be responsible for a decreased number of erythrocytes as suggested in anemia of chronic disease. Erythropoietin is the hormone responsible for regulation of erythropoiesis. It has been reported

that IL-1 (á or â), TNF-á, and TGF-â inhibited production of erythropoietin from the hepatoma cell line Hep3B.[11]

2) Periodontal inflammation often results in bleeding from the gingiva. Therefore, a hypothesis was postulated that the direct loss of blood might be responsible for the reduction in the number of erythrocytes, but this has not been scientifically proven.[5]

3) An anemic state might be a risk factor for periodontal disease. The reduction of erythrocytes might decrease oxygen in gingival tissue.[5] An animal study showed reduced bone formation in rats with experimental anemia.[12]

The results of our study suggest an association between parameters of anemia and periodontal disease. These results suggest that there is a potential cross-effect of anemia on periodontal status and general health issues.

A tendency toward anemia in patients with chronic periodontitis was also previously reported,[5,6,7,10] whereas a reverse relationship was presented in data collected during the third National Health and Nutrition Examination Survey (NHANES III), which suggested that individuals with anemia may be more likely to have periodontal disease.[13]

The results of the present study are in agreement with studies,[8,14] which also reported lower hematocrit, lower numbers of erythrocytes, lower hemoglobin levels and higher erythrocyte sedimentation rates in periodontitis patients when compared to healthy controls. A significant improvement in hemoglobin value and erythrocyte count were also demonstrated after periodontal treatment, including surgery in patient with generalized chronic periodontitis with anemia.[15]

Some contradicting studies are also found in the literature.[16] They failed to show any association between hemoglobin levels and periodontal status. Some studies with negative results were not recent,[5,6] and it is supposed that the methodology of blood analysis as well as the criteria of periodontitis definition have changed since then.

The present study does have some limitations. All subjects were recruited from the out patient department of the college. This may limit the ability to extrapolate these findings to the general population. Also, the study period was relatively short and sample size was also small. Also this study did not include data on serum levels of iron, transferrin, ferritin, soluble transferrin receptor, or cytokines to distinguish anemia of chronic disease from other anemia such as iron-deficiency anemia.

Further studies with larger sample size and longer duration with intervention are needed to make the conclusions more credible.

Conclusion

A positive relationship was observed between the haematological parameters viz. Hb, PCV, MCV, MCH and MCHC and chronic periodontitis, suggesting that like other chronic conditions, periodontitis, may lead to anemia.

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Photodynamic therapy - Light at the end

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Abstract

Periodontal disease is a multifactorial disease with various factors contributing to the disease process. The treatment of all periodontal diseases involves mechanical cleaning of tooth surfaces to remove mineralized and non-mineralized bacterial deposits (calculus and plaque). Chemical antimicrobial agents act as adjuncts to mechanical therapy and are used in prophylactic and therapeutic regimens for dental plaque related diseases.The adverse effects of these approaches include irreversible hard tissue damage, gingival recession, inability to maintain therapeutic concentrations and resistance to the antimicrobial agents. A novel approach, photodynamic therapy (PDT), could be a solution to these problems. Lethal photosensitization of many bacteria, both Gram positive and Gram negative was found in many studies. The advantage of this new approach includes rapid bacterial elimination, minimal chance of resistance development and safety of adjacent host tissue and normal microflora. However, clinical follow-up studies are needed to confirm the efficacy of the procedure. **(Terna J Dent Sci 2014;3(1):59-62)**

Key words: Calculus, plaque, photodynamic therapy

Introduction

Periodontal disease is initiated by pathogenic plaque biofilm and characterized by bacteria induced inflammatory destruction of tooth-supporting structures and alveolar bone.[1] With a constant bacterial challenge, the periodontal tissues are continuously exposed to specific bacterial components that have the ability to alter many local functions. The role of the inflammatory process is to protect the host and limit the pathogenic effect of biofilm, thus determining some tissue destruction as a collateral effect of the defence. The extent and severity of damage vary among individuals and over time, mainly influenced by individual's immune and inflammatory responses to microbial challenge.[2] At present state, an effective and widely accepted treatment approach for periodontal disease is the mechanical removal of the bacterial biofilm and their toxins from the tooth surface by scaling and root planing, making it compatible with biologic reattachment that is the basis of any eventual adjunctive therapy.[3]

Conflict of interest and source of funding
The authors declare that there is no conflict of interest concerning the contents of the study.
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Traditionally, scaling and root planing procedures can be performed by hand and/or powered instruments. However, complete removal of bacterial deposits within the periodontal pockets is not necessarily achieved with conventional mechanical therapy. In addition, access to areas such as furcations, concavities, grooves and distal sites of molars is limited.[4] Currently, efficient anti-infective treatments with reduced side effects are being searched for. Local and systemic antibiotics may lead to bacterial resistance, allergies, gastrointestinal disorders and others, reducing patient compliance or advising against the prescription.[5]

To overcome these problems, the scientific community is seeking alternatives to antibiotic treatment. Periodontal researchers found that photodynamic therapy (PDT) is advantageous for suppressing anaerobic bacteria that lead to periodontal diseases.[6]

Photodynamic therapy

Photodynamic therapy (PDT) can be defined as eradication of target cells by reactive oxygen species produced by means of a photosensitizing compound and light of an appropriate wavelength.[7] It could provide an alternative for targeting microbes directly at the site of infection, thus overcoming the problems associated with antimicrobials. Photodynamic action describes a process in which light, after being absorbed by dyes, sensitizes organisms for visible light induced cell damage. Allison et al. described PDT as a therapy that "is truly the marriage of a drug and a light".[8]

PDT is based on the principle that a photo activatable substance (the photosensitizer) binds to the target cell and can be activated by light of a suitable wavelength. During this process, free radicals are formed (among them singlet oxygen), which then produce an effect that is toxic to the cell. To have a specific toxic effect on bacterial cells, the respective photosensitizer needs to have selectivity for prokaryotic cells. Although several authors have reported the possibility of a lethal photosensitization of bacteria in vivo and in vitro,[9] others have pointed out that Gram negative bacterial species, due to their special cell wall, are largely resistant to PDT.[10]

PDT involves three components: photosensitizer, light and oxygen. When a photosensitizer is irradiated with light of specific wavelength it undergoes a transition from a low-energy ground state to an excited singlet state. Subsequently, the photosensitizer may decay back to its ground state, with emission of

fluorescence, or may undergo a transition to a higher-energy triplet state. The triplet state can react with endogenous oxygen to produce singlet oxygen and other radical species, causing a rapid and selective destruction of the target tissue (Fig. 1).

This utilization of oxygen in the production of reactive oxygen species is known as photochemical oxygen consumption. The triplet-state photo sensitizer reacts with biomolecules by two mechanisms. The Type I reaction involves electron D hydrogen transfer directly from the photo sensitizer, producing ions or electron D hydrogen removal from a substance molecules to form free radicals. These radicals react rapidly with oxygen resulting in the production of highly reactive oxygen species (superoxide, hydroxylradicals, hydrogen peroxide). The Type II reaction produces electronically excited and singlet oxygen.

These two reactions indicate the mechanisms of tissue D cell damage which is dependent on both oxygen tension and photo sensitizer concentration.[11] PDT produces cytotoxic effects on subcellular organelles and molecules. Its effects are targeted on mitochondria, lysosomes, cell membranes and nuclei of tumor cells. Photosensitizer induces apoptosis in mitochondria and necrosis in lysosomes and cell membranes.[12]

Photosensitizers

More than 400 compounds are known with photosensitizing properties including dyes, drugs, cosmetics, chemicals and many natural substances. Most of the sensitizers used for medical purposes belong to the following basic structures:

- Tricyclic dyes with different meso-atoms: Acridineorange, proflavine, riboflavin, methylene blue, fluorescein, eosine, erythrosin, rose Bengal
- Tetrapyrroles: Porphyrins and derivatives, chlorophyll, phylloerythrin, phthalocyanines
- Furocoumarins: Psoralen and its methoxy-derivatives xanthotoxin, bergaptene.[13]

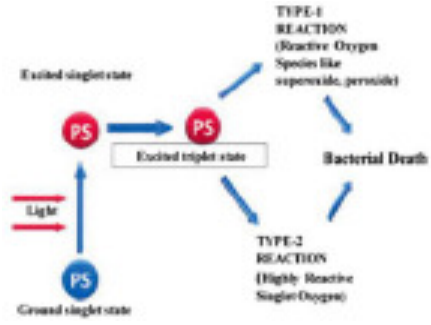

Fig. 1. *Mechanism of action of PDT. Photosensitizer (PS) upon irradiation with light at appropriate wavelength undergoes transition into singlet and triplet state. It reacts with endogenous oxygen to form reactive species and highly reactive species causing cell death.*

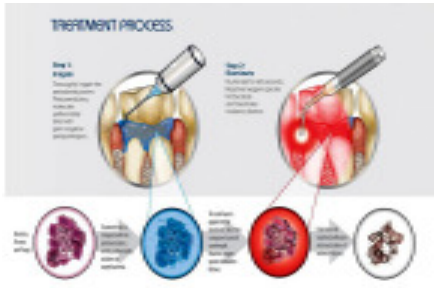

Fig. 2: *Showing the steps of application of a PDT in the treatment of periodontitis. (A) Periodontally diseased site before treatment. (B) Mechanical debridement using hand curettes. (C) Application of the photosensitizer via syringe at the diseased site that contains residual bacteria. Occasionally, excess dye solution is removed using water spray (D) [From: Takasaki AA, Aoki A, Mizutani K, Schwarz F, Sculean A, Wang CY, et al. Application of antimicrobial photodynamic therapy in periodontal and peri implant diseases. Periodontol. 2000 2009;51:109 40].*

Fig. 3: *Pre-operative probing depth*

Fig. 4: *Intra-operative (site being treated with laser)*

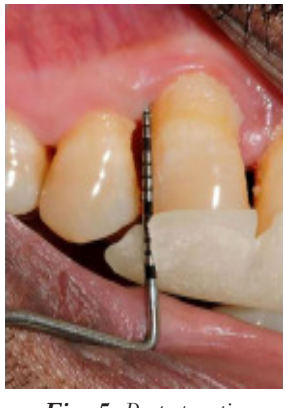

Fig. 5: *Post-operative probing depth*

Optimal properties of a photosensitizer[11]

- Highly selective
- Low toxicity and fast elimination from skin and epithelium
- Absorption peaks in the low-loss transmission window of biological tissues
- Optimum ratio of the fluorescence quantum yield to the interconversion quantum yield
- High quantum yield of singlet oxygen production in vivo
- High solubility in water, injection solutions and blood substitutes
- Storage and application light stability

Use of Pdt in Periodontics

Effect on periodontopathic bacteria:

Ten patients (between 40 and 50 years of age) with active periodontal sites (in a total of 253 teeth) were treated with SRP in a study. Based on the results of the study, patients treated with PDT achieved the greatest bacterial reduction among all examined individual germs and reported a reduction of 87.57% ($P < 0.05$).[14]

Various studies have shown that Gram-positive bacteria are most susceptible to PDT.

Photo-killing of Gram negative bacteria is also possible. However, experiments were published showing PDT resistant Gram-negative bacteria. This resistance can be overcome by cell wall modification or by the selection of appropriate sensitizing dyes.[15]

Effect on Bone loss:

A study to evaluate the influence of PDT on bone loss in furcation areas in rats with

experimentally – induced periodontal disease was conducted and it was concluded that within the parameters used in this study, PDT may be an effective alternative for control of bone loss in furcation areas in periodontitis.[16]

The use of PDT in furcation involvement in induced periodontitis shows some advantages over the use of conventional antimicrobials, such as the reduced need for flap procedures and shorter treatment time; as local therapy, with lack of microflora disturbance in other sites of the oral cavity. PDT is also beneficial during the maintenance of periodontal therapy because it may act on the biofilm and eliminate the need for the removal of additional root substance by mechanical retreatment. Thus, the patient may experience less dentinal hypersensitivity. This therapy also serves as an adjunct to mechanical therapy in sites with difficult access.[17]

As an adjunct in non surgical periodontal therapy: Twenty-four subjects with chronic periodontitis were randomly treated with scaling and root planing followed by a single episode of PDT (test) or scaling and root planing alone (control). Full-mouth plaque score (FMPS), full-mouth bleeding score (FMBS), probing depth (PD), gingival recession, and clinical attachment level (CAL) were measured at baseline and 3 and 6 months after therapy. Primary outcome variables were changes in PD and CAL. Microbiologic evaluation of A.actinomycetemcomitans, P.gingivalis, Pintermedia, T.forsythia, T.denticola, F.nucleatum, Campylobacter rectus, Eubacterium nodatum, E.corrodens, and Capnocytophaga spp. was performed at baseline and 3 and 6 months following therapy by using a commercially available polymerase chain reaction test. It was seen that the additional application of a single episode of PDT to scaling and root planing failed to result in an additional improvement in terms of PD reduction and CAL gain, but it resulted in a significantly higher reduction in bleeding scores compared to scaling and root planing alone.[18]

Effect on plaque biofilm

Biofilm in oral cavity causes two of the most common diseases, dental caries and periodontal diseases. An effective approach of periodontal therapy is to change the local environment to suppress the growth of periodontal pathogens. Micro-organisms in gelatinous matrix (glycocalyx) are less accessible to antibiotics. Using antimicrobial agents to treat periodontitis without disruption of the biofilm ultimately results in treatment failures. It is difficult to maintain therapeutic concentrations at the target sites and target organisms can develop resistance to drugs. This resistance is minimized by using PDT. Polysaccharides present in extracellular matrix of oral biofilm are highly sensitive to singlet oxygen and susceptible to photo damage.

Breaking the biofilm may inhibit plasmid exchange involved in transfer of antibiotic resistance and disrupt colonization. PDT is even effective against antibiotic resistant bacteria. Antioxidant enzymes produced by bacteria may protect against some oxygen radicals, but not against singlet oxygen.[19]

Effect on periodontal maintenance

In a study done to assess the possible added benefits of repeated applications of PDT, showed improved clinical outcomes after 6 months in the treatment of residual pockets (defined as PPD>5 mm); in patients enrolled in a maintenance care programme. PDT was performed adjunctive to the regular debridement at maintenance visits.[20]

PDT in Implantology

Laser PDT can be used in implantology to promote osseointegration and to prevent peri implantitis. Studies have shown that laser photo biomodulation can be successfully used to improve bone quality around dental implants, allowing early wearing of prostheses. The results of a study showed significant differences on the concentration of calcium hydroxyapatite on irradiated and control specimens and concluded that infrared laser photo biomodulation does improve bone healing.[21]The percentage of bone fill and re osseointegration also improved with photo biomodulation.[22]

Advantages of PDT[23]

- PDT is a non invasive, painless, local therapy that has shown increased patient acceptance. PDT offers thorough elimination and eradication of pathogens in inaccessible areas of periodontal pockets.
- The risk of bacteremia after periodontal debridement can be minimized
- Reduced need for flap procedures and shorter treatment time, with lack of microflora disturbance in other sites of the oral cavity

Adverse effects

- Photodynamic action has the potential of photo toxic or photo allergic unwanted side effects.
- Pain or discomfort, often described as burning, stinging or prickling restricted to the illuminated area is commonly experienced. It usually occurs in the early part of light exposure, peaking within minutes, then leveling out during the remainder of exposure, and probably reflects nerve stimulation and D or tissue damage by reactive oxygen species.
- Hyper pigmentation or hypo pigmentation can occasionally be seen in treated areas and usually resolves within six months.[17]

Current status of PDT

Currently, clinical evidence is insufficient to prove the effectiveness of PDT in treating periodontal diseases. Oral biofilm is most common cause of periodontal disease. Hence, development of novel delivery and targeting approaches are suggested to counteract the resistance of biofilms to PDT. The future of PDT lies in the development of targeted therapy, bacteriophage-photosensitizer conjugates, and non antibody-based targeting moieties.[24]

Conclusion

This new strategy of using PDT is less traumatic and quicker in the treatment of periodontal diseases but it is still in the experimental stage of development and

testing. Development of new photosensitizers, more efficient light delivery systems and further clinical studies are required to establish the optimum treatment parameters for PDT. Clinical trials are also encouraging. In addition to reducing clinical parameters; in Perimplantitis cases, there is some evidence that PDT will also inactivate virulence factors of periodontal pathogens, enhancing post-treatment outcomes. PDT offers numerous advantages, particularly in avoiding emergence of antibiotic resistance species, requiring less technical skills and reducing operating time in comparison to manual scaling and root planing. As a new approach, PDT could be useful as an adjunct or conventional therapy during the maintenance period.

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Pre-operative implant imaging by Cone Beam CT

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Abstract

Dental implants have galvanized the field of dentistry. The use of dental implants to replace missing teeth, has increased exponentially. Pre-operative diagnostic imaging of the edentulous site by CBCT is a valuable aid in selecting the size of implant and in implant planning. It has greatly increased the success rate of dental implants. This article reviews the applications of cone beam CT in diagnostic contribution to pre-surgical evaluation of implant site. **(Terna J Dent Sci 2014;3(1):63-65)**

Key words: CBCT, dental implant site assessment.

Introduction

Dentistry has always been at the wave front of new technology. Advances in dental care have rapidly been assimilated from inception to reality throughout the history of the profession.[1] From air rotors to x-rays, the rapidity of these advances has not slowed.

Dental implantology was pioneered in the 19th century. Over the years implant dentistry has grown rapidly and has been aided by technological advances. Implants have improved the quality of life for patients who are able to keep their natural teeth, fix acute problems, and give patients the benefit of restorative improvements for a modern lifestyle.[2]

The success of implant surgery and restoration relies mostly on diagnostic imaging. This technology contributes to all stages of implant treatment, from pre-surgical site evaluation to post-operative assessment of integration, and long-term periodic evaluation of implant status. Various imaging modalities have been used for dental implant assessment in the different stages of implant treatment. These include various intraoral radiography (film-based and digital), panoramic radiography, computed tomography (CT), cone-beam computed tomography (CBCT).[3]

This article reviews the applications of cone beam CT in diagnostic contribution to pre-surgical evaluation and treatment planning.

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Implant site assessment by CBCT

CBCT scan provides 3dimensional and cross-sectional images of the region of interest. The residual bone can be then assessed and the best site for implant placement can be selected by studying various criteria. These include:

1. **Bone height and width** [4,5,6]
   The overall height from the crest of the ridge to the nearest anatomic landmark can be measured (Fig. 1). The width can be measured on coronal sections as well as on axial sections.

   The distance between the inner or outer cortical plates is measured. Maximum and minimum bone width can be measured (Fig. 2).

2. **Bone density** [7]
   Subjective bone density can be assessed using CBCT. It helps in assessing the quality of bone, which is critical in implant placement (Fig. 3).

3. **Long axis of the alveolar bone**
   Axis orientation is important for successful alignment of the implant within the boundaries of the jaws. Risks such as perforation, dehiscence, and fracture can therefore be avoided with CBCT 3d imaging.[8]

4. **Identify and localize internal anatomies, such as nerves and sinus cavities** [9, 10, 11]
   CBCT helps to determine the relationship of the implant to adjacent vital structures. These structures include nasal cavity, maxillary sinus, incisive foramen, inferior alveolar canal, mental foramen, anterior loop of inferior alveolar canal, submandibular fossa etc. The position and length of implant can be adjusted accordingly (Fig. 4).

5. **Identify pathology in 3d** [12]
   3d volume helps in assessing the presence of gross anomalies. Retained root pieces, cysts, tumors etc. can be easily studied and their exact location and extent can be assessed.

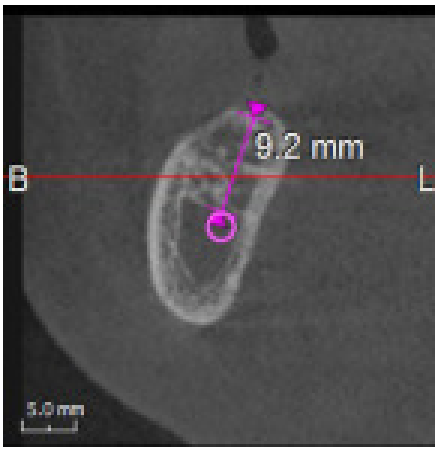


Fig.1: *Height of alveolar bone*

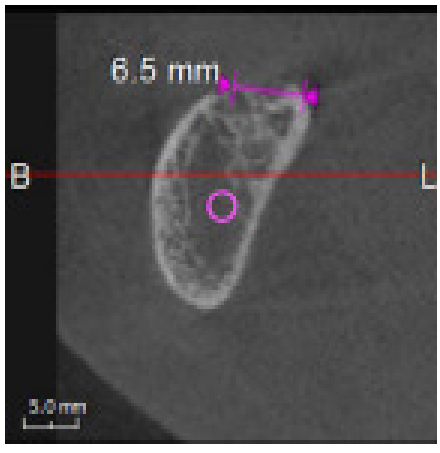


Fig.2: *Width of alveolar bone*

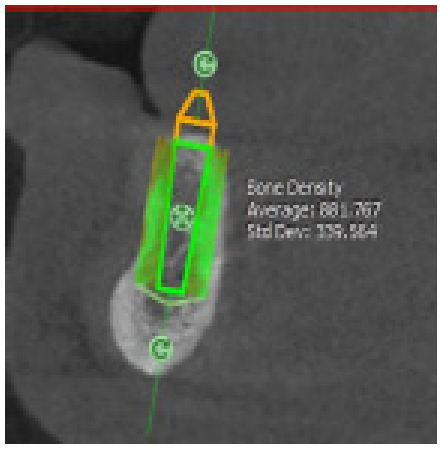
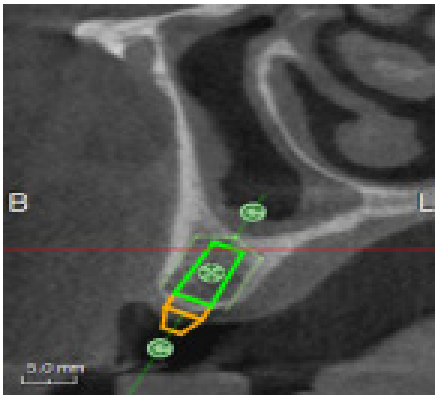


Fig.3: *Bone density evaluation*



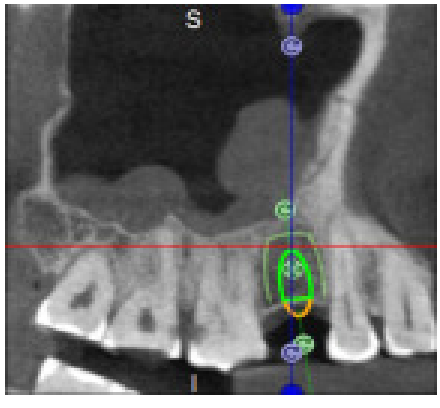


Fig.4: *Relation to adjacent anatomic structures*

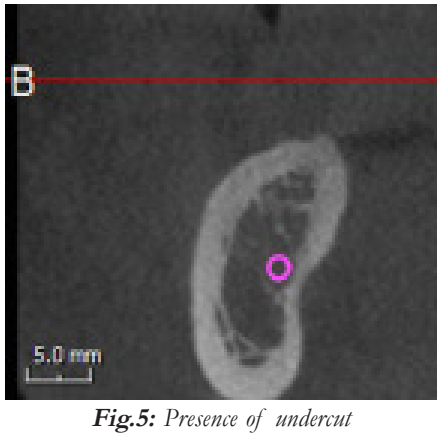


Fig.5: *Presence of undercut*

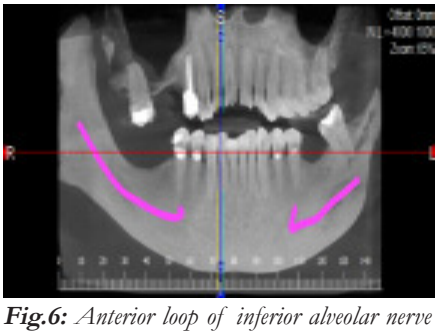


Fig.6: *Anterior loop of inferior alveolar nerve*

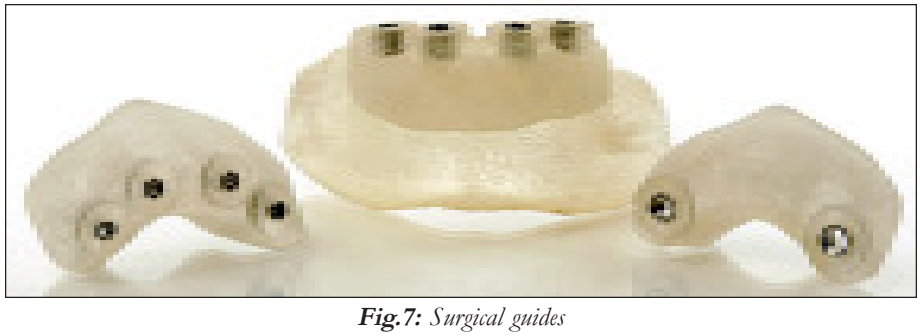


Fig.7: *Surgical guides*

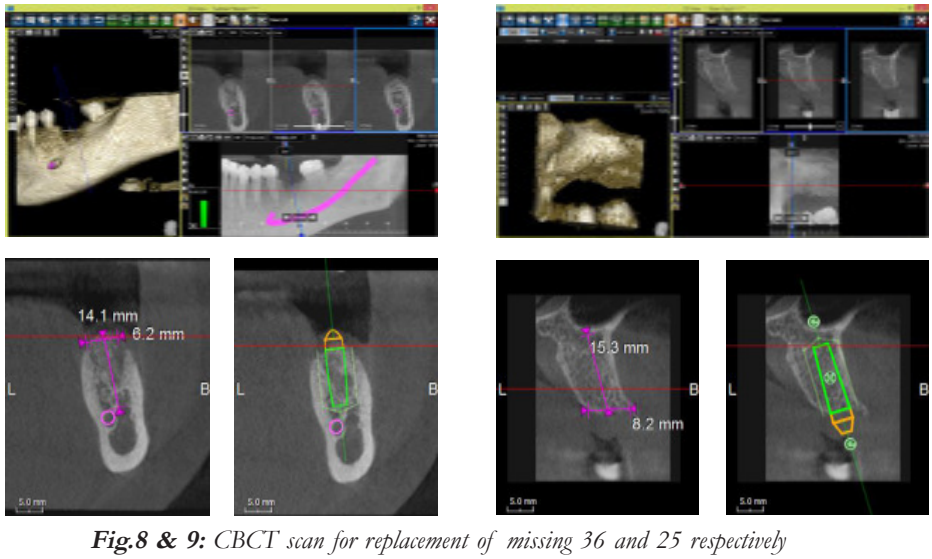


Fig.8 & 9: *CBCT scan for replacement of missing 36 and 25 respectively*

6. **Presence or absence of undercut** [11]
   Presence of an undercut may lead to perforation of implant. Undercuts can be easily assessed on cross-sectional images. Implant selection and angulation can be accordingly adjusted to avoid perforation of the implant (Fig. 5).

7. **Anterior loop of inferior alveolar nerve** [9, 13]
   Inferior alveolar nerve generally exits the mandible through mental foramen. In some cases it may continue anteriorly further from the mental foramen; known as the anterior loop of inferior alveolar nerve. If it is not identified, then implants in the anterior region may impinge on the anterior loop leading to implant failure. This anterior loop, if present, can be easily identified on CBCT scans (Fig. 6).

8. **Use of third party software and fabrication of surgical guide** [14, 15]
   CBCT data can be converted to DICOM format. This DICOM data can be viewed using third party softwares. These include Simplant, in2guide, 3diemme etc. A .STL file is generated by scanning the patients cast. These softwares, then merge the CBCT data with the .STL file. Virtual implants can be placed and precise surgical guide can be fabricated from it. These surgical guides ensure accurate implant placement as planned (Fig.7).

Conclusion

Thus, accurate measurement of alveolar bone height, width, subjective density; as well as presence of pathology, closeness to vital structures, presence of undercut can be easily assessed by CBCT. Surgical guides have enabled the clinician to achieve precise implant placement. CBCT has also overcome the shortcomings and disadvantages of the various other imaging techniques. Thus CBCT is an ideal imaging technique for accurate implant placement.

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Management of calcified canals

Abstract

The future of teeth with calcified canals appears much brighter today than ever before due to the advancements in diagnostic aids and instrumentation techniques. Use of liquid EDTA and different forms of EDTA may aid in locating the orifice but always advance instruments slowly in calcified canals. Use of different ultrasonic instruments in the pulp chamber to loosen debris in the canal orifices is explained in this article. The use of newer nickel titanium rotary orifice – penetrating instruments should be considered.

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Key words: Calcifications, EDTA, calcific metamorphosis, ultrasonics

Introduction

Calcified canals, deemed inaccessible, still harbour bacterial biofilms. Calcifications arise from chronic inflammation in the pulp due to caries, trauma or medication in close to proximity.[1]

Types of calcification:

1) Dystrophic calcification
2) Metastatic calcifications
3) Calcinosis

Etiology

1. Idiopathic Formation
2. Trauma
3. Aging
4. Hereditary Disorders
5. Caries
6. Restorative Procedures

Mechanism of calcification

Localized metabolic dysfunction
in pulp tissue
↓
Hyalinization of tissue
↓
Fibrosis
↓
Mineralization
↓
Deposition of calcified mass in tissue

Conflict of interest and source of funding

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Calcific metamorphosis

It is the pulpal response to trauma that is characterized by rapid deposition of hard tissue within the root canal space. The clinical picture of calcific metamorphosis has been described as a tooth that is darker in color than the adjacent teeth, and exhibits a dark yellow color because of a decrease in translucency from a greater thickness of dentin under the enamel.[1]

Pulp stones

Pulp stone is a discrete calcified mass of calcium-phosphorus, ratios comparable to that of dentin.

Classification of pulp stones [2]

- Based on Structure
- Based on Location
- Based on Size
- According to Shaffer
- According to Kronfield

Based on structures

1) True
2) False

Based on location

1) Free
2) Adherent
3) Embedded

Based on size

1) Fine
2) Diffuse mineralizations (also called fibrillar mineralization)

Classification by Shaffer

1) Free
2) Attached
3) Interstetial

Classification by Kronfield

1) Discrete
2) Diffuse

Management of calcified canals

A. **Radiograph:**

Radiographs should be taken at three different angulations

a) Straight – on to the bucco-lingual dimension to determine the position of the head of the bur in the root canal in the mesio- distal dimension.

b) Radiograph taken with a 20° horizontal angulation with the cone shifted distally.

c) Radiograph taken with a 20° horizontal angulation with the cone directed mesially

This will allow the clinician to map the canal anatomy three dimensionally. This gives the clinician strong clues about the complexity of the space to be negotiated and subsequently enlarged. Digital radiography is immensely helpful in this regard.

B. **Rubber dam**
The rubber dam should always be employed. Visual and tactile control over all phases of the endodontic process, calcified canals as well, is compromised without it.

C. **Knowledge of canal anatomy**
In a study involving over 500 pulp chambers, Krasner and Rankow found that the CEJ is the most consistent and important anatomic landmark for determining location of the pulp chambers and root canal orifices. These authors proposed nine guidelines or Laws, of pulp chamber anatomy.[3,4]

1) **Law of centrality**
It states that the floor of the pulp chamber is always located in the center of the tooth at the level of the CEJ. However, it is critical that the operator understand that the law is consistently true only at the level of the CEJ and unrelated to the occlusal anatomy. Since we know that the pulp chamber is always in the center of the tooth at the level of the CEJ, the initial penetrating bur should be directed towards the center of the CEJ.

2) **Law of concentricity**
It states that the walls of the pulp chamber are always concentric to the external surface of the tooth at the level of the CEJ.

3) **Law of the CEJ**
It states that the distance from the external surface of the clinical crown to the wall of the pulp chamber is the same throughout the circumference of the tooth at the level of the CEJ, making the CEJ the most consistent repeatable landmark for locating the position of the pulp chamber.

4) **First law of symmetry**
Except for the maxillary molars, canal orifices are equidistant from a line drawn in a mesiodistal direction through the center of the pulp chamber floor.

5) **Second Law of symmetry**
Except for the maxillary molars, canal orifices lie on a line perpendicular to a line drawn in a mesiodistal direction across the center of the pulp chamber floor.

6) **Law of color change**
The pulp chamber floor is always darker in color than the walls.

7) **First law of orifice location**
The orifices of the root canals are always located at the junction of the walls and the floor.

8) **Second law of orifice location**
The orifices of the root canals are always located at the angles in the floor-wall junction.

9) **Third law of orifice location**
The orifices of the root canals are always located at the terminus of the roots' developmental fusion lines.

D. Vizualization aids in locating canals [4]

1. Anatomic familiarity
2. Vision = Magnification + illumination
3. Dyes - Methylene Blue is water soluble that can be applied to dried access cavities. It will be absorbed into orifices, fins and isthmus areas and help to "Map" the location of the orifices.
4. Bubble test – When sodium hypochlorite is flooded into the access cavity, it dissociates into Na^+ and Cl^- liberating free oxygen. This oxygen forms bubbles when it comes in contact with pulpal tissue. This indicates a positive Bubble or "Champagne" test.
5. Transillumination – A fibreoptic wand is held at the cervical level perpendicular to the tooth, any overhead light is turned off.
6. Red line test – In vital teeth, blood frequently emanates from a fin, isthmus or orifice area. It serves a similar purpose as dyes.
7. White line test – In necrotic teeth, dentinal dust accumulates into an open space such as a fin, isthmus or orifice and forms a white dot or line, forming a "roadmap" which will lead to the canal orifice – for eg., the MB2 orifice. The access cavity must be dry while performing this test.

Endodontic explorer

8. The DG-16 (Hu-Friedy, Chicago, IL) endodontic explorer is used to identify canal orifices and to determine canal angulation.
9. The JW-17 endodontic explorer (CK Dental Industries, Orange, CA) serves the same purpose, but it is thinner, stiffer and can be used to identify calcified canals as well.
10. The DG-16 and The JW-17 endodontic explorers are used to scout the floor of pulp chamber. It is relatively safe instrument as it will not gouge solid dentin, but will penetrate the orifice of calcified canal and resist dislodgement or stick when pulled out. It can be used to pick away the calcifications in more controlled manner than the slow speed round bur.

The LN bur (Caulk/ Denstply, Tulsa, USA)
The LN Bur is a unique half-round bur on a long neck. Its design allows for deep drilling alongside posts or broken instruments. The LN Bur also may be used to break through calcification to locate canals.

The total length of the bur is 28 mm.[4]

Mueller bur (Brasseler, Savannah, GA, USA)
Extended-shank round burs, such as the Mueller bur (Brasseler USA, Savannah, GA) and the LN bur (DENTSPLY Maillefer, Tulsa, OK), are also useful for this purpose. If a tooth has a receded pulp chamber and calcified orifices, the clinician often must cut into the root to locate and identify the canal orifices.

E. **Instruments for coronal flaring**

1) Gates Glidden drill

2) **Micro-openers (Dentsply-Maillefer, Tulsa, OK)** are excellent instruments for locating canal orifices when a rubber dam has not been placed. These instruments have #.04 and #.06 tapered tips with offset handles for better visualization.
Advantage Includes:
– Limited-length cutting blades
– 0.04 and 0.06 taper
– Enhanced tensile strength
– Easier to locate, penetrate and perform initial canal enlargements procedures
– Unobstructed vision when operating teeth with limited access

3) Micro-Debriders (Dentsply Maillefer, Tulsa, OK) are Hedstroem Files with a taper of .02 characterized by a short shaft bent at an angle of 200° and a long grip in plastic. The Micro-Debriders are to be used only with a circumferential ûling movement and are availabe in ISO diameters 20 and 30.

F. Ultrasonics

BUC tips
- The BUC-1 and BUC-1A can be used for gross dentin removal, moving access line angles, cutting a groove in the mesial access wall to drop into MB2 canals, and for quickly and carefully unroofing pulp chambers.[5]
- The BUC-2, with its disk-like tip, can be used to smoothly and safely remove attached pulp stones from the pulp chamber floor. The smaller version BUC-2A has a 1.0 mm diameter and can be used for corners of molar access prep and bicuspid access prep.
- The BUC-3 and BUC-3A are extremely active instruments with sharp tips. They are used for chasing canals halfway up a root.

CPR tips
- The CPR-1 is used for vibrating posts and cores and as an aid in crown and bridge removal.
- The CPR-2D has a contra-angled head and durable shape that provides enhanced energy for removal of core materials. It is also excellent for chasing calcified canals, uncovering hidden orifices, trephining around obstructions within the pulp chamber, and eliminating materials extending below the orifice.
- CPR-3D, CPR-4D, CPR-5D allows excellent vision and access while chasing calcified canals, eliminating obstructions.
- CPR-6 , CPR-7, CPR-8 made of titanium alloy, which results in a smoother cutting action with less chatter, thereby increasing tactile sense.

SybronEndo places irrigation ports at the base of the tips (except the BUC-3, BUC 3A and KiS tips) instead of hollowing out or making a cutout in the shaft. Irrigation ports at the base mean stronger tips that are less susceptible to breakage.

Diamond coating improves access by allowing discriminatory removal of dentin and restorative material along the lateral side of the instrument during use. These instruments gently sand the material away during "brush" cutting. The smooth cutting action enhances tactile sense, reducing "chatter" caused by ultrasonic cavitations.

ProUltra Endo Tips
- It was designed by Dr Clifford J. Ruddle, They are nonsurgical Endo Tips designed for removing intracanal obstructions, eliminating pulp stones, disassembling cores and dental restorations and dislodging posts and broken instruments.
- Tips 1-5 are coated with zirconium nitride for efficiency. Tips 6-8 are a special titanium alloy for precision in areas with limited access. All the tips have unique contra-angles and parallel shafts for better access and visibility. The tips have lengths and diameters designed to progress down into the canal.

G. Different filing systems

1. No. 8#, No. 10 # files
   • Usually a No. 8 or No. 10 K –file is placed into the orifice, and an attempt is made to negotiate the canal along with EDTA.

2. Canal Pathfinder and Canal Pathfinder CS
   • An alternative option is to use instruments with reduced flute, such as a Canal Pathfinder (JS Dental, Ridgefield. Conn.) or instruments with greater shaft strength such as the Pathfinder CS (Kerr Manufacturing Co.). Canal Pathfinders (JS Dental, Ridgefield. Conn.) are stainless steel pathfinder instruments features a minimal taper and are used for negotiating difficult or calcified canals. Pathfinder CS (Kerr Manufacturing Co.) features the same minimal taper as stainless steel Pathfinders but are made with carbon steel to

help negotiate difficult or calcified canals faster and more efficiently.[6]

3. Golden medium K- files
4. C file
5. C + files

H. Magnification

1. Loupes :-

All loupes use convergent lenses to form a magnified image. The simplest form of magnification is single-lens loupes (used by jewellers). These have a set focal length and working distance. To overcome this, multi-lens optics are used. This provides a higher depth of magnification and an improved working distance. Ideal magnification recommended for loupes is 2.5x. This offers the best compromise between weight, optical performance as well as cost. Loupes with magnification of 4.5x are also available but also such loupes would be significantly heavier.[7]

2. Dental Operating Microscope:-

Microscopes can provide magnification upto 30x. Dental operating microscope can provide good depth of view at high magnifications. Fiber optic light of a Dental operating microscope is 2-3 times more powerful than that emitted by surgical loupes with clip-on lamps. Greater the lighting, magnification and improved visualization that can be brought into the procedure.[8,9]

G. Chelating agents

1) EDTA
2) Citric acid
3) Polyacrylic acid
4) Malleic acid

Chelator preparations have been advocated frequently as adjuncts for root canal preparation, especially in narrow and calcified root canals.

Different forms of gel EDTA[10]

- RC-Prep - It contains 15% EDTA, 10% urea peroxide and glycol in aqueous ointment base.
- Glyde FILE Prep - Is composed of EDTA & carbamide peroxide (product of Dentsply)
- File EZE - 19% EDTA (product of Ultradent)
- Calcinase slide - 15% Na EDTA + 58-64% water

Different forms of liquid EDTA

- R-EDTA (Roth International) has 17% EDTA solution with addition of 0.84g cetyl-tri-methyl-ammonium bromide (Cetrimide) to reduce the surface tension.
- EDTA-T Contains 17% EDTA+ sodium lauryl ether sulfate (Tergentol) as a detergent.
- EGTA is a chelator whose main component is ethylene glycol bis (b-amino-ethyl-ether) N,N,N,N-tetra acetic acid. It is reported to bind Ca+ more specifically than EDTA.
- EDTAC contains EDTA (15%) + Cetavlon (quaternary ammonium bromide), it increases action of EDTA by reducing its surface tension.

Conclusion

Search for calcified canal is a challenge and requires patience. Good magnification, illumination, proper armamentarium is required. Calcification is seen worse coronally, once the coronal calcification is cleared then apical path is usually negotiable.

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