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Editorial

The application of digital photography has permeated every aspect of modern dentistry. It is simple and fast, and it is used for case documentation; treatment planning; and patient, peer, and lab intercommunication, collaboration, and education. In fact, it would be difficult to imagine today's dental practice without the use of photography. Clinical photography offers an instant look at the patient's case which can be effortlessly reviewed, monitored, and compared with the patient's other records. With the proliferation of smart phones and tablets, clinicians now have the ability to interconnect a dental camera with other communication devices and systems in the operatory and laboratory. Although standardization in clinical photography requires effort, planning, and a systematic approach to procedures and protocols, the ability to capture high-quality dental photographs each and every time will invariably increase practice productivity. Although some clinicians may prefer to take dental photographs themselves, delegating this task to another member of the dental team, such as a dental assistant, hygienist, or dental technician, may be worth considering.

Since photographs have become an essential document in dentistry, it is mandatory to have the understanding on its use to obtain the needed advantages. The knowledge is necessary from the principles of photography, equipment, accessories, lighting, settings, setups, post processing, purpose of its use - printing, documentation, and publication. Hence it would be highly appreciated if eth dental colleges and the Indian Dental Association branches conduct continuing dental education programmes on the subject clinical photography with resource persons of expertise in this field.

Dr. Pradeep Kumar C

Editor

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THE ETIOLOGY OF EARLY CHILDHOOD CARIES A NARRATIVE REVIEW

*Pocha Reddy Sharath, **Nusrath Fareed, ***Dhanya Muralidharan, ****Shanthi Margabandhu, *****Kiran Kumar D

Dr. Pocha Reddy Sharath

Abstract

Background

Early Childhood Caries (ECC) is a serious form of dental caries that affects the primary dentition of young children. The present review provides etiological issues of ECC in light of its current understanding which has become a significant problem in many developing countries and some minority communities.

Types of Studies Reviewed

The Authors examined the literature regarding etiological factors of ECC and also explored several predisposing factors unique to young children related to the implantation of cariogenic bacteria, immaturity of the host defense systems, as well as behavioral patterns associated with feeding and oral hygiene during early childhood. To accomplish these goals, priority was given to systematic reviews and meta-analysis followed by randomized controlled trials, non-randomized clinical trials and cross sectional studies.

Results and Conclusions

The review highlights the complex etiology of ECC. It was found to occur as a result of infection with mutans Streptococcus that occurs vertically in most cases from the mother. Oral conditions including consumption of sugary foods and fluids and hypoplastic enamel at the time of infection may significantly favour the establishment of earlier infection and earlier onset of caries. Role of childhood feeding patterns to ECC was found to be inconclusive.

Key Words: early childhood caries; nursing bottle caries; dental caries; breast feeding; streptococcal infection; preschool.

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Introduction

Early childhood is a stage in human development and is generally the sum of toddlerhood and play age. During the last several years, investigations have paid considerable attention to the relationship between oral and general health. Many children have inadequate oral and general health because of active and uncontrolled dental caries.[1, 2]

It is important to understand the reason for the increased susceptibility to caries in very young children in order to identify risk factors and vulnerable groups. Early Childhood Caries (ECC) is the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child under the age of six.[3] Although the etiology of ECC is similar to that of the other types of coronal and smooth surface caries[4] yet it is associated with several factors such as implantation of cariogenic bacteria, immaturity of the host defense system, behavioral patterns associated with feeding and oral hygiene, unique to very young children.

So far, findings on the interplay of various factors and their impact on ECC are controversial. The present review focuses on recognition of the complex etiology of ECC by addressing a more comprehensive set of contributing factors.

Literature review

This is an update on the etiology and risk factors of ECC. A broad search of the PubMed database was conducted using "early childhood caries", "nursing bottle caries", "dental decay in children" as index terms. Relevant papers published in English were identified after a review of the abstracts and retrieved studies were limited to articles including children aged 5 years and under. Systematic reviews were given the highest priority, followed by meta-analysis, randomized controlled trial, non-randomized clinical trials and cross sectional studies.

Evolution of the term

In 1862, an American physician, Abraham Jacobi, was the first to describe the clinical appearance of early childhood caries, which he observed in one of his own children. Review of the epidemiology of caries in early childhood includes the terms "Les dentes noires des toutpetits" (black teeth in small children), nursing bottle mouth, nursing caries, nursing bottle syndrome, night bottle mouth, and baby bottle tooth decay.[5,6]

Center for Disease Control and Prevention [1994] coined the term "*Early childhood caries"* in order to better emphasise the multi-factorial pathogenesis of the disease.[7] Conference on early childhood caries, organised by the National Health Institute (USA), added two further definitions/descriptions, which were *Rampant infant caries* and *Early childhood dental decay* (RIECDD).[7] Subsequently, Wyne[7] distinguished three types of early childhood caries (ECC):

- ECC type I (mild to moderate form): isolated carious lesions in molars and/or incisors (often between two and five years of age).
- ECC type II (moderate to severe form): labial and palatal carious lesions in the maxillary incisors and primary molars.
- ECC type III (severe form): almost all teeth affected, including the lower incisors; in general, this form occurs between the three and five years of age.

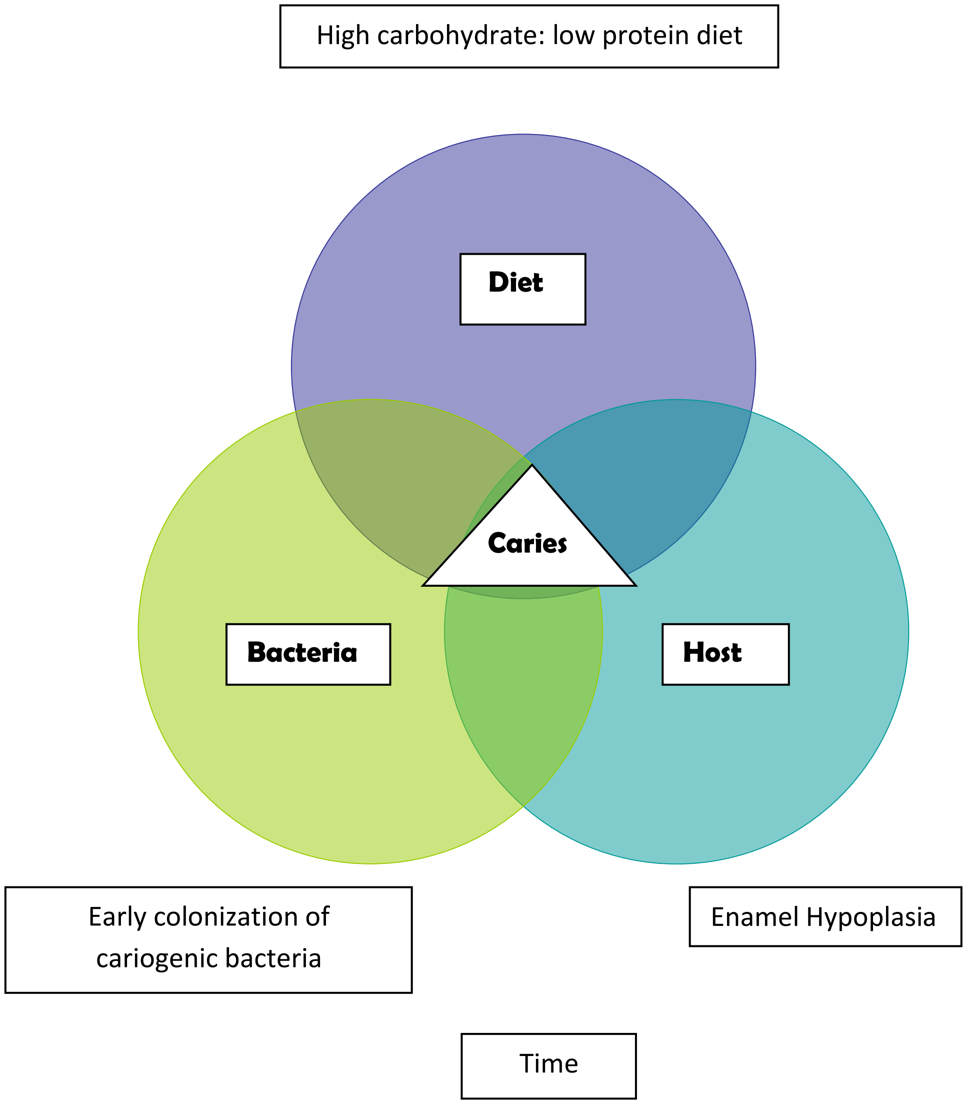

Fig 1: Etiological factors of ECC

The Etiology

- **General Host factors**

  Age and Gender

Undoubtedly age is a significant predictor of ECC. Both the prevalence of ECC and the rate of decay increase as the age at the first dental visit increased.[3,5] Children who visit the dentist at later age have more teeth for longer lengths of time, increasing their odds of developing decay.

Regarding gender, males are reported to be more affected, which may be due to later exfoliation of primary teeth, resulting in later eruption of the permanent teeth thereby creating an underestimation of ECC in the primary teeth of female children.[3,5]

Race and ethnicity and socioeconomic status (SES)

There appears to be clear social gradients associated with ECC. Cultural norms including concern for oral health, prenatal diet that could contribute to enamel hypoplasia, care of primary teeth, child rearing practices, low educational level of parents and access to dental and medical care among ethnic minorities and children who live in poverty are factors that contribute to caries risk.[6,8,10]

One of the limitations in synthesizing data from multiple studies is that there is a lack of consensus for the measurement of SES in a meaningful way.[6]

Family size (more than 4 persons) was found to be significantly associated with the rate of decay and this may be due to the financial strain or limited time that larger family's encounter, which may curb their ability to adequately meet the oral health needs of their children. It is likely that the demands of a large family may reduce the amount of time parents devote to practicing oral hygiene when compared to children from smaller families.[6,9,10]

General Medical condition of children and ECC

Children with very low birth weight, systemic infections especially of respiratory tract, middle ear and sleep associated problems pose an additional risk in development of ECC. These are related to high prevalence of enamel defects and extensive uses of medications sweetened with sugars and also sleep associated feeding as a means of sleep management.[11-14]

Host Immunity

Human Leukocyte Antigen [HLA] class II molecule plays an important role as a predisposing factor for ECC and positive HLA-DRB1*04 may increase the risk of ECC ten times. Differences in Major Histo-Compatibility molecules may cause some variations in immune response against microorganisms and may influence children's susceptibility to ECC.[15]

- **Local Host factors**

Several host factors can predispose an individual or a particular tooth to dental caries. These may include immature enamel and defects of the tooth tissues and hyposalivation.

Developmental structural defects- increase caries risk: Surface irregularities such as pits and grooves predispose to plaque retention, increased Mutans Streptococci colonization, and, possibly decreased clearance of carbohydrates, increasing vulnerability to the caries process.[5,8]

Enamel defects in the primary dentition are most associated with pre-, peri- or post natal conditions such as low birth weight, and child's or mother's malnutrition or illness. Also variety of environmental pollutants including maternal smoking have been found to be significantly associated with enamel defects and dental caries in children.[8,15]

Endogenous factors, such as saliva characteristics may be an answer to the question that what makes some children develop ECC while others do not. Saliva provides the main host defense system against dental caries. It has a major role in the oral clearance of foods and the buffering of acids generated in dental plaque. Studies have found resting pH and buffering capacity of saliva to be lower among children with ECC compared to caries free children.[16]

With regards to nursing caries, the continuous feeding of sugars at night-time when the flow rate of saliva is at the lowest, probably increases the caries risk of the infant significantly.[8,16]

- **Agent**

Mutans Streptococci (MS) - principal bacteria isolated from children with ECC. There is abundance of evidence showing that MS is the principal organism isolated from the carious teeth of children with ECC.[17-19]

Caufield et al [18] in their study found MS was detected in 25 percent of infants by 19 months and in 75 percent by 31 months of age and went on to suggest that the critical time for oral colonization by MS lay within a well-delineated age range of 19 to 31 months of age, a period designated as the "window of infectivity". This led to hypothesis that MS colonized the mouth of infants only during the period when teeth emerge into the oral cavity.[20]

Beginning of the twentieth century studies showed MS in the predentate oral cavity raising doubt over "window of infectivity" theory.[21] Irrespective of the window period of infectivity, longitudinal studies have shown that *the timing of first MS detection appears to be a strong determinant of high caries risk.*[21]

Acquisition of MS by the child

The primary care taker of the infant, usually the mother, has been shown to provide the reservoir of MS that infects the child. Studies have reported strong relationship between the maternal MS levels and their infants.[21] Infection of a child's oral cavity with MS can occur via salivary contacts between the mother and child especially when engaging in practices such as using her own spoon to feed the child. This would be even more significant if the mother had a high saliva MS count and feeding the child with sucrose-containing foods.[22, 23] Transmission can occur due to complications during pregnancy and is termed as *vertical transmission*.[22]

Considering cultural differences within families such as eating from the same plate, using the same toothbrush and ineffective utensil-washing routines increases the likelihood of transmission as MS has ability to survive for several hours outside the oral cavity. It is also possible that a child can acquire MS from outside the family such as in a nursery school environment. This mode of transmission is known as *Horizontal transmission.*[23,24]

- **Substrate**

Diet influences the expression of virulence but may also affect the intrinsic virulence of cariogenic microorganisms.

Common sugars of significance in ECC include the sucrose, monosaccharide glucose and fructose, which are present in fruit and honey. A review of the role of substrate in ECC by Reisine and Douglass [6] found that the total amount of sugar in children's diet was not predictive of dental caries; however, the frequency of sugar intake was. Frequent consumption of sugar favors the establishment of cariogenic bacteria and provides continuous substrate that influences the initiation and progression of the caries.[16,21]

Milk- is it cariogenic?

The cariogenicity of milk is often questioned because plain bovine milk is a common fluid placed in the feeding bottle in many cases of ECC and also prolonged breast-feeding has been putatively associated with ECC. Several investigators have suggested that milk is not cariogenic but protective. The mechanism of protection by milk appears to work through first, decreasing demineralization and increasing remineralisation of enamel, probably through increasing the calcium and phosphate concentrations in plaque, as well as increasing the acid buffering capacity of plaque through catabolism of peptides by plaque bacteria. Milk proteins such as α-1casein may concentrate in the acquired pellicle, and act as inhibitors of Mutans streptococcus adherence to saliva-coated hydroxyappatite.[16,26,27]

However, it is important to emphasize that adding sucrose to milk renders milk cariogenic.

Acid fruit drinks: A predisposing factor for ECC

It is now well known that acids found in fruit juices and soft drinks may decrease the oral pH. Loss of enamel from excessive consumption of fruit drinks in children has been documented in previous studies. In the presence of sugars in the drinks, fall in pH is likely to enhance resulting from bacterial fermentation of carbohydrates and thus cause more profound enamel demineralization.[6,16,25]

- **Behavioral Mechanisms influencing cariogenicity of diet**

Infant Dietary Practices

Two bottle-related behaviors have attracted most interest in ECC research- the use of bottle feeding at night/nap time and its use beyond 12 months.

Use of the bottle at night-time is associated with higher sugar intake and accumulation of milk around the teeth, as the children do not swallow the milk until sufficient volume is reached during sucking. Investigators reported that length of contact with bottle at night-time is important and is positively associated with caries.

Irrespective of the nursing bottle content, the insertion of a nipple into the mouth of the infant has several consequences- the flow of the saliva are restricted onto the palatal surfaces of maxillary teeth, as well as the labial surfaces of incisors.[25] These site differences in oral clearance explain in part the distribution of the carious lesions in ECC which are characteristically localized to the maxillary primary incisors and first molars.

The second behavior implicated in the development of maxillary anterior caries is use of a *bottle beyond the age of 1 year*. Several reports indicate that children with caries eliminate bottle use 4-7 months later than those without caries.[23,24]

Another area of controversy is whether prolonged or at-will breast-feeding can cause maxillary anterior caries. Breastfeeding has been assumed to be associated with ECC when the consumption pattern was *ad libitum* feeding, frequent breastfeeding, prolonged breastfeeding, and mainly frequent breastfeeding during the night. Allowing children to nurse at will during the night was reported to be associated with the presence of caries.[25,26] Evidence on Pacifier use as a risk factor for ECC is generally weak due to inconsistencies in study methods used.[23]

Improved research designs including more detailed definition and description of bed time bottle use, could better determine its role in ECC development. *These findings suggest that the role of feeding pattern in infant's caries development is not as clear as previously thought.*

Relationship between breastfeeding and ECC is a highly controversial topic. There is considerable conflict and confusion regarding prolonged and on demand breast-feeding and its implications in the development of ECC.

Systematic reviews concluded that the findings on prolonged breastfeeding (compared with other types of infant feeding) did not provide clear evidence of strong association between breast feeding and ECC because of inconsistencies regarding definitions of breast feeding and consideration of potential confounder factors like fluoride exposure, oral hygiene practice and dietary habits.[27-30]

Biomechanics of breastfeeding however differs from those of bottle feeding as milk during breastfeeding is expressed into the soft palate and swallowed so no pooling of milk around teeth occurs. And also there is lack of evidence that human milk is cariogenic and other factors, such as oral hygiene, may be more influential in caries development than on-demand breastfeeding.[27] Thus, on the basis of the current scientific evidence, it appears that the relationship between unrestricted (ad libitum) breastfeeding and an increased risk of developing caries is equivocal. Furthermore, breast milk production is based largely on infant demand; thus, restricting breastfeeding after the first tooth erupts is detrimental because it threatens to decrease the mother's milk supply and disrupt the child's feeding patterns.[27]

Conclusion

ECC is a multifactorial, transmissible and infectious disease in which substrate, saliva, immature host defense system, developing bacterial flora and time factor are key elements involved in pathogenesis. High risk children belong to ethnic minority group and to low income families with poor behavior and attitudes. Early colonization by Mutans Streptococci (MS) is associated with increase ECC development with bacteria being transmitted in both vertical and horizontal ways.

Scientifically rigorous research is needed to elucidate whether associations exist between breastfeeding and ECC, as such evidence is lacking. Dental professionals should encourage parents to begin practicing healthy oral hygiene habits for their children as soon as the first tooth erupts, at the same time keeping the intake of sugar-sweetened beverages to a minimum.

References

1. U.S. Public Health service, office of the surgeon general, National institute of Dental and Craniofacial research. Oral health in America. A report of the surgeon general. Rockville, Md: U.S. department of Health and human service, U.S. public health service;2000; *NIH publication* 00-4713.
2. Jackson SL, Vann Jr. WF, Pahel BT, Kotch JB, Lee JY. Impact of poor oral health on children's school performance. *Am J Pub Health* 2011; 101(10):1900-06.
3. American Academy of Pediatric Dentistry. Definition of Early Childhood Caries. Reference Manual 2006-7 *Pediatr Dent* 2006; 28:13.
4. Fass E. Is Bottle feeding of milk a factor in dental caries? *J Dent Child* 1962; 29:245-51.
5. Milnes AR. Description and epidemiology of nursing caries. *J Public Health Dent* 1996;56(1):38–50.
6. Reisine S, Douglass JM. Psychosocial and behavioural issues in early childhood caries. *Community Dent Oral Epidemiol* 1998; 26(suppl1):32-44.
7. Wyne AH. Early childhood caries: nomenclature and case definition. *Community Dent Oral Epidemiol* 1999; 27:313-15.
8. Ribeiro NM, Ribeiro MA. Breastfeeding and early childhood caries: a critical review. *J Pediatr (Rio J)* 2004; 80:199-210.
9. Mark Gussy G, Elizabeth G Waters, Orla Walsh, Nicolo M Kilpatrick. Early childhood caries: current evidence for aetiology and prevention. *J Pediatr & child health* 2006; 42:37-43.
10. Hallett KB, O‟Rourke PK. Social and behavioral determinants of early childhood caries. *Aust Dent J* 2003; 48(1):27-33.
11. Lai PY, Seow WK, Rogers YI, Tudehope DI. Enamel hypoplasia and dental caries in very-low birth weight children: a longitudinal, case-controlled study. *Pediatr Dent* 1997; 19:42-9.
12. Alaki SM, Burt BA, Gaetz SL. Middle ear and respiratory infections in early childhood and their association with early childhood caries. *Pediatr Dent* 2008; 30(2):105-10.
13. Shachi D. shantinath; David Breigner; Bryan J. Williams. The relationship of sleep-associated feeding to nursing caries. *Pediatr Dent* 1996; 18(5):375-8.
14. Seow WK. Enamel hypoplasia in the primary dentition: A review. *J Dent Child* 1991; 58:441-52.
15. Bagherian A, Nematollahi H, Afshari J.T, Moheghi N. comparison of allele frequency for HLA-DR and HLA-DQ between patients with ECC and caries-free children. *J Indian Society Pedod Prevent Dent* 2008; 26(1):18-21.
16. van Houte J, Gibbs G, and Butera C. Oral flora of children with "nursing bottle caries." *J Dent Res* 1982;61:382-5.
17. Berkowitz RJ, Turner J, and Hughes C. Microbial characteristics of the human

dental caries associated with prolonged bottle-feeding. *Arch Oral Biol* 1984;29:949-51.

18. Caufield PW, Cutter GR, and Dasanayake AP. Initial acquisition of mutans streptococci by infants. Evidence for a discrete window of infectivity. *J Dent Res* 1993;72:37-45.
19. Hallett KB, O‟Rourke PK. Early childhood caries and infant feeding practice. *Community Dent health* 2002;19(4):237-42.
20. Jenkins GN, Ferguson DB. Milk and dental caries. *Br Dent J* 1966;120:472-7.
21. Bibby BG, Huang CT, Zero D, Mundroff SA, Little MF. Protective effect of milk again in vitro caries. *J Dent Res* 1980;59:1565-70.
22. Vacca-smith AM, Van Wuyckhuyse BC, Tabak LA, Bowen Wh. The effect milk and casein proteins on the adherence of streptococcal mutans to saliva coated hydroxyappatite. *Arch Oral Biol* 1994;39;1063-9.
23. Seow WK: Biological mechanisms of early childhood caries. *Community Dent Oral Epidemiol* 1998;26(supp1):8-27.
24. Louis M. Abbey, Richmond Va. Is breast feeding a likely cause of dental caries in young children? *J Am Dent Assoc* 1979;98:21-23.
25. Bowen WH: Response to Seow: Biological mechanisms of early childhood caries. *Community Dent Oral Epidemiol* 1998;26(supp1):28-31.
26. Serwint JR, Mungo R, Negrete VF, Duggan AK, Korsch BM. Child rearing practices and nursing caries. *Pediatrics* 1993;92:233-7.
27. White V. Breastfeeding and the risk of early childhood caries. *Evid Based Dent* 2008;9(3):86-8.
28. Valaitis R, Hesch R, Passarelli C, Sheehan D, Sinton J. A systematic review of the relationship between breastfeeding and early childhood caries. *Can J Public Health* 2000;91(6):411-7.
29. Lindsey Rennick Salone, William F. Vann, Jr. And Deborah L. Dee. Breastfeeding: an overview of oral and general health benefits. *J Am Dent Assoc* 2013;144(2):143-51.
30. Kramer MS, Vanilovich I, Matush L, et al. The effect of prolonged and exclusive breast-feeding on dental caries in early school age children: new evidence from a large randomized trial. *Caries Res* 2007;41(6):484-8.

OCCLUSAL BIOMECHANICS: A REVIEW


Dr. Neethu S. Babu

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Abstract

Biomechanical features of occlusal contacts are important in understanding the role of the occlusion contributing to masticatory function. Cusp-fossa contact is the typical pattern of occlusion between upper and lower teeth. This includes static relations, such as during clenching, and dynamic relations when mandibular teeth contact in function along the maxillary occlusal pathways, as during mastication. To obtain repeatable static and dynamic occlusal contact information provided by the morphology of the teeth, maximum voluntary clenching and chewing movements with maximum range are needed. In addition to the standard occlusal concepts of centric relation or centric occlusion and group function or cuspid protection relation, biomechanics in static and dynamic cusp fossa relationship should be included to develop occlusal harmony. The aim of this literature review is to convey the importance of cuspal inclines, as a component of a cusp or a fossa which have a role in the management of occlusal load distribution and occlusal guidance.

Key Words: Occlusion, biomechanics, masticatory system, biting, chewing movement

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Introduction

Dental occlusion can be defined as the contact relationship between the masticatory surfaces of maxillary and mandibular teeth[1] and is an important variable in the delivery of restorative, prosthodontic, and orthodontic treatments. In biomechanics, two aspects of dental occlusion are important namely static relation such as clenching and three dimensional dynamic relations when mandibular teeth contact in function along the maxillary occlusal pathways.

The dental arches during both static and dynamic interactions sustain loads from jaw closing muscle contraction indirectly through food or directly with upper and lower tooth contact. [2] Occlusion can also be pathologic as well as physiologic. A physiologic occlusion is an ‘‘occlusion in harmony with the masticatory system,’’ and a pathologic occlusion is an ‘‘occlusal relationship capable of producing pathologic changes in the stomatognathic system.’’ Even when the occlusal scheme appears to be in balance and in harmony with the temporomandibular joints, what first appears is the physiologic occlusion. It can become a pathologic occlusion if factors such as the degree of loading, the individual’s adaptive capability, and various psychosocial issues become involved.[3]

In this review, the biomechanical role of the cusp-fossa relation is discussed in two situations such as static situation and dynamic occlusion. Also the chewing patterns with occlusal guidance are analysed.

Static occlusion

Static occlusion is the study of contacts between the teeth when the jaw is not moving. Simulated static clenching in intercuspal position is often adopted for analyzing the way in which occlusal loading is sustained. It is the occlusion that the patient nearly always makes when asked to close their teeth together.[4]

(i) Cusp-fossa relation distributes the occlusal loading. Masticatory efficiency is desirably maximized by the multi-cusped nature of dental occlusal surfaces which increases the size of the occlusal contact area of posterior tooth crowns and serves to effectively disperse occlusal forces.[2] A study done by Hidaka et al[5] determined that the broadened occlusal contact area would be helpful in mitigating excessive occlusal forces on the teeth and the increase in contact area would give rise to a fairly constant average bite pressure. It is difficult to record accurate information of bite force directions in vivo. Dos Santos et al[6] did a study in which he developed mechanical models to simulate function and provide vector analysis based on static equilibrium of forces generated in a mandible at 10 different positions and concluded that cusp inclines have a profound influence on the forces acting within the dentition. The magnitude of these resultant forces was more intense on the left molars (65.51% of the total masticatory force) where the cuspal inclines are less steep. For the right molars where the incline angles are steeper, the resultant was 34.47% of the masticatory force. When there are large differences between cuspal inclines, the mechanical advantages in terms of loading goes to the side where cusps are less flat.

(ii) Occlusal stability can be defined as the equalization of tooth contacts that prevents tooth movement after closure.[1] To check occlusal stability, maximum voluntary clench should be recorded. As the force of clenching increased, a significant increase was observed in the bite force and the area of occlusal contact over the whole of the dentition.[5] In a study done by Riise et al[7] he concluded that when clenching directly without food the number of tooth contacts was larger with firm pressure than light pressure. There is currently no measuring device to directly and reliably evaluate occlusal stability. Instead, surface electromyographic (SEMG) analysis has been used as an indirect approach.[8] A high level of clenching activity could be a sign of health that can be taken as a goal of occlusal therapy.

(iii) Mandibular balance or equilibrium has been used to describe the positional status of the mandible, including the dentition and temperomandibular joint. Ideally, a physiologically balanced occlusion permits the mandible to be in a comfortable, stable position with close contacts between the TMJ elements when the maxillary and mandibular dentitions are in maximum intercuspation. If occlusal changes cause the occlusion to become physiologically nonbalanced, the spatial relationships between maxillary and mandibular dentition may change in a manner that the condyles, discs, and fossa will no longer be able to remain in an ideal positional relationship with close contact.[9] During tooth clenching, the activity of jaw closing muscles causes rotation of the mandible upward around the terminal hinge axis.[5] The location of contacts which determines the balance of the mandible during clenching predominates in generating muscle bilateral force than the size or number of teeth involved.[10]

Dynamic occlusion

Dynamic occlusion refers to occlusal contacts made when the jaw is moving. Dynamic occlusion is also termed as ‘’Articulation’’. Adams and Zander[2] classified occlusal contacts in chewing into two categories: 62% occurring during jaw closing and 38% occurring during jaw opening. The mandible is moved by the muscles of mastication and the pathways along which it moves are determined not only by these muscles but also by two guidance systems.

The posterior guidance system of the mandible is provided by the temporomandibular joints. If teeth are touching during a protrusive or lateral movement of the mandible then those (touching) teeth are also providing guidance to mandibular movement. This is the anterior guidance and this is provided by whichever teeth touch during excentric movements of the mandible.[4]

(i) Occlusal guidance: A study done by Woda A et al[11] showed that the pattern of masticatory movement reflects the individual pattern of occlusal guidance. The occlusal phase of chewing is especially interesting because food particles are being pulverized in this phase. For efficient chewing the upper and lower teeth must come together in a congruent fashion with less variation than in other phases. The closing phase of chewing cycle is more often analysed. This may be as a result of the customary posterior teeth and/or canine guidance for lateral excursive movements. During the closing, the buccal cusp of the maxillary teeth provide guidance and during opening, the lingual cusp of the chewing site may not contact, or there may be light contact.

(ii) Chewing cycles: Chewing is a rhythmic process that involves both opening and closing movements of the jaw in the sagittal plane as well as lateral movements. During the chewing cycle the lower jaw first falls away from centric occlusion towards the working side**.** Chewing cycles have been analysed by shape and duration as well as by maximum jaw velocities. More irregular chewing patterns are seen in subjects with malocclusion especially posterior cross bite and deep bite. Although it is the posterior teeth that take a predominant role in guiding chewing movement, the anterior occlusion has also got an effect on the chewing cycle.

Posterior unilateral crossbite is a malocclusion that may lead to mandibular deviation. During chewing with unilateral crossbite, the jaw will first move laterally before medially to disengage the teeth in crossbite showing an increased frequency of reverse sequencing cycle with a reduced masseter activity.[12] The percentage of such chewing cycles was found significantly reduced after correction of unilateral crossbite relation. Subjects with normal occlusion maintain the antero-posterior position of the mandible during the initial opening whereas deep bite subjects immediately move their mandible posteriorly.

Techniques in testing occlusal contacts

The location of occlusal contact is important in distributing occlusal load and occlusal glide factors in determining chewing factors. Therefore, the techniques to record and evaluate dental occlusal contact in both static and dynamic situations are important when analyzing the biomechanical role of occlusion.[2]

Tooth contacts have been recorded in a variety of groups with occlusal articulating paper, occlusal strips or silk, alginate impression, black silicone bite registration material, photocclusion, gnathosonics and T-scan systems.[13] Instruments that are used for measuring mandibular movements are also helpful in detecting occlusal contacts during chewing movements.

Summary

The masticatory (or stomatognathic) system is generally considered to be made up of three parts: the teeth, the periodontal tissues, and the articulatory system. Functional or normal occlusion is necessary for a healthy stomatognathic system in the provision of dental aged care, orthodontic therapy, quality prosthetic and restorative treatment. Occlusion can be defined very simply as the contacts between teeth. Having stated that occlusion simply means the contact between teeth, the concept can be further refined by defining those contacts between the teeth when the mandible is closed and stationary as the static occlusion, and those contacts between teeth when the mandible is moving relative to the maxilla as the dynamic occlusion.

The importance of ‘occlusion’ in dental practice is based primarily upon the relationships that it has within these interconnected biomechanical systems. When one considers how almost all forms of dental treatment have a potential for causing occlusal change, the need to establish what constitutes good occlusal practice is overwhelming and obvious. Extensive tooth wear might be a basic design principle in the human as a mechanism for functional adaptation. The masticatory forces are usually generated in submaximum level. So inorder to study contact location the occclusal contact intensity with criteria determined through voluntary maximum clench need to be assessed. The exaggerated chewing motion is also recommended to assess the smoothness and ease of occlusal guided horizontal movements.

References

1. The Glossary of Prosthodontic terms. *J Prosthet Dent* 2005;94:10-92.
2. Wang M, Mehta N. A possible biomechanical role of occlusal cusp -fossa contact relationships. *J Oral Rehabil* 2013;40:69-79.
3. Racich M. Orofacial pain and occlusion: Is there a link? An overview of current concepts and the clinical implication. *J Prosthet Dent* 2005;93:189-96.

4. Davies S, Gray R. What is occlusion? *Br.Dent.J* 2001;191:235-45.

5. Hidaka O, Iwasaki M, Saito M, Morimoto T. Influence of clenching intensity on bite force balance,occlusal contact area,and average bite pressure. *J Dent Res* 1999;78:1336-44.

6. Dos Santos J, Blackman R, Nelson S.. Vectorial analysis of the static equilibrium of forces generated in the mandible in centric occlusion, group function and balanced occlusion relationships. *J Prosthet Dent* 1991;65:557-67.

7. Riise C, Ericsson S. A clinical study of the distribution of occlusal tooth contacts in the intercuspal position at light and hard pressure in adults. *J Oral Rehabil* 1983;10:473-80.

8. Jimenez I. Electromyography of masticatory muscle in three jaw registration positions. *Am J Orthod Dentofacial Orthop* 1989;95:282-8.

9. Wang M, He J, Widmalm S. The effect of physiological non balanced occlusion on the thickness of temporomandibular joint disc: A pilot autopsy study. *J Prosthet Dent* 2008;99: 148-52.

10. Wang M, He J, Wang K, Svensson P, Widmalm S. SEMG activity of jaw closing muscles during biting with different unilateral occlusal supports. *J Oral Rehabil* 2010;37:719-25.

11. Woda A, Vigneron P, Kay D. Nonfunctional and functional occlusal contacts:A review of the literature. *J Prosthet Dent* 1979;42:335-41.

12. Neill D, Howell P. Computerised kinesiography in the study of mastication in dentate subjects. *J Prosthet Dent* 1986;55:629-38.

13. Ogawa T, Koyano K, Suetsugu T. Correlation between inclination of occlusal plane and masticatory movement. *J Prosthet Dent* 1998;26:105-12.

ELUSIVE CANALS: NO MORE AN ENIGMA!

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Dr. Bizenzah. C. P

Abstract

Each tooth in the dentition is unique in its anatomy and morphology, and the variations reported are so numerous that it compels one's mind to think that each tooth in each individual is unique. With the advent of science and the use of modern technology these variations have become more effortless for detection and at the same time more demanding for treatment. This article provides insight into the complexities of maxillary first molars and its treatment.

Key Words: MB2, Mesiobuccal canal 2, Access cavity

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Introduction

"***Of all the phases of anatomic study in the human system, one of the most complex is the pulp cavity morphology***". - M T Barrett

The dental pulp is the most unique organ and a successful root canal therapy requires a thorough knowledge of tooth anatomy and root canal morphology, which may be quite variable within the norm. Root canal system anomalies rarely occur outside the norm. Even the incidence of the various anomalous root anatomy forms within the adult human dentition can be quite variable.[1]

For each tooth in dentition wide variations have been reported in literature, which precludes the mastering of detecting such variations by all means.A number of factors contribute to the variations found in these studies which include ethnic background, age and gender of the population studied, source of teeth, the study design and the method used for assessing such canals.[1]

The maxillary first molar has fascinated researchers and clinicians for a variety of reasons ***(Fig 1a, 1b)***. This particular tooth has the largest volume and has generated more research than any other tooth in the mouth. Endodontically, it is one of the most misunderstood teeth, and presents a variety of considerations for the treating practitioner.[2] Of the three roots of maxillary first molar, the mesiobuccal root is associated with highest degree of anatomical variability. It is quiet flat mesio-distally. This is easily explained if one considers that it may contain a ribbon shaped root canal or much more often, two distinct root canals. ***(Fig 1a, 1b)***.[3]

The percentage in which two root canals exists within this root vary according to the various authors, but they all agree on one fact: they may be present in more than half of cases[3] (53% according to Hess[4], 60% according to Pinneda and Cuttler[5], 64%

according to Smith[6] and Nosonowitz and Brenner[7], 69.4% according to Acosta Vigouroux and Trugeda Bosaans[8], 84% according to Aydos and Milano[9], 93% according to Stropko[10], and 96.1% according to Kulid[11].

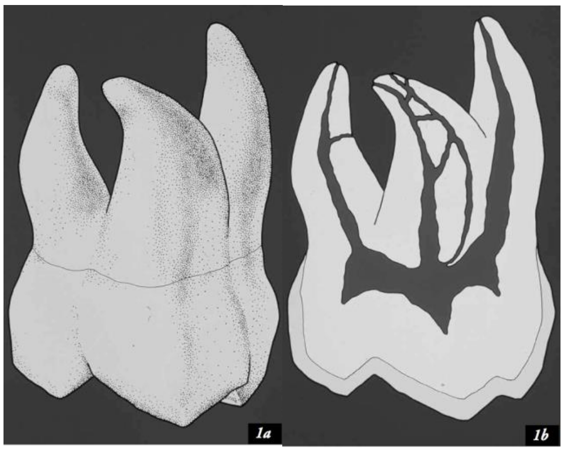

Fig 1a: A mesial-oblique view reveals the buccal to lingual breadth of the mesiobuccal root. Anticipate and appreciate the inner root canal system anatomy.

Fig1b: Research and clinical studies demonstrate the MB root holds two canals more than 70 percent of the time with frequent anastomosing between systems

Histological evidence, however, suggests the presence of two MB systems approaching a remarkable 100 percent.[11] These systems communicate frequently along their lengths, and terminate separately in two or more portals of exit greater than 58 percent of the time.[12-13] The thorough clinician must, therefore, assume that all maxillary first molars have four canals until proven otherwise.

Infrequently, but on occasion, maxillary first molars can exhibit extra canals in their other roots. It is essential, therefore, to completely de-roof the pulp chamber, expand the access cavity's axial walls, and carefully explore the pulpal floor for aberrant orifices/systems ***(Fig 2a, 2b)***.[14]

Fig 2a: The operating microscope offers excellent documentation and vision at 15X. Note the MB^{1}, MB^{2}, and MB^{3} orifices in the maxillary first molar.

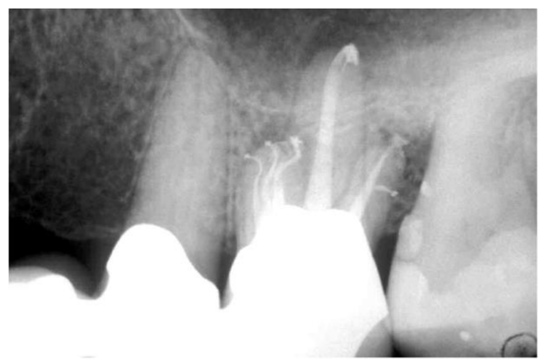

Fig ***2b: The pack reveals three MB systems with significant apical one-third recurvature, palatal bifidity, and a significant lateral canal off the DB system.***

Terminology

Looking into the access preparation toward the mesiobuccal axial wall, the larger, more buccally positioned, more readily identifiable orifice/system is called the MB1. The smaller, more palatally positioned, most frequently overlooked orifice/system is called the MB2.[14]

The orifice of the "MB2" – more appropriately named "mesiopalatal canal" –

is located on the groove that joins the palatal and mesiobuccal canals at a variable distance from the latter.[15]

Location

To assist locating the MB2 system, the clinician should be prepared to extend the access cavity mesially **(Fig 3).** It is useful to know that all orifices originate on the pulpal floor, and lie approximately on the same plane, and the clinician may need to move the mesial axial wall of the access mesially rather than chase apically into the pulpal floor to identify the MB2.[14]

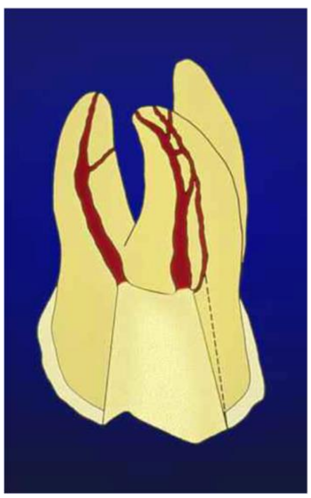

Fig 3: The dotted lines graphically represent how the access cavity must be expanded to remove the shelf of overlying dentin hiding the MB 2 canal

In looking for it, it may be helpful to search for a small depression at the level of above mentioned groove, where the point of the endodontic probe is engaged. Sometimes, however the probe cannot enter, because it encounters the mesial wall of pulp chamber where it forms a very acute angle with the floor that hampers the visual and tactile detection of the canal opening ***(Fig 4)***. Because of this angle, the MB2 can be very difficult to negotiate. The mesial wall of pulp chamber has a dentinal shelf, which frequently hides the underlying MB2 orifice.[15]

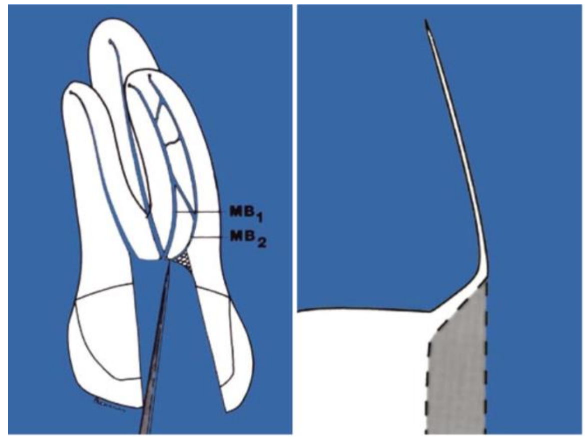

Fig 4: The drawing shows the angle between the pulpal floor and the shelf of dentin of the mesial wall of the access cavity. (Courtesy:Dr. S. Buchanan).

Identification

There are a number of strategies that, when used in combination, greatly increase the identification of the MB2 orifice/ system.[16] The more useful concepts/ techniques include the following:

1. Philosophically believing the MB2 is present motivates the clinician to actually be in action to find it.
2. Complete access is absolutely necessary if MB2 orifices/systems will be routinely identified. The access cavity needs to be completely deroofed and expanded mesially at the expense of the MMR in the groove/orifice region. "Finishing" the access cavity eliminates a shelf of overlying dentin, exposing the MB2 orifice.

3. Firmly probe the isthmus or developmental groove with an explorer. The clinician's fingers should blanch, and the thumb from the offhand can assist in directing forces down the long axis of the explorer to punch through a thin roof of overlying dentin. Explorers are often discarded as tips collapse, much like when the smallest files are discarded during cleaning and shaping procedures.

4. Magnification is a critically essential element to consistently identify the MB2 orifices. Clinicians should wear loupes, magnification glasses, or ideally, use the dental operating microscope to visualize pulpal floor anatomy and extra orifices. Microscopes afford unsurpassed lighting, magnification, optics, ergonomics, and potential to add a variety of additional accessories, including documentation packages.

5. Lighting parallels magnification in importance, and is enhanced with fiber-optic handpieces and straight wand lights held by the dental assistant directed buccal to lingual either above or below the rubber dam. Operating head lamps beam a column of light that is coaxial with the line of sight which significantly enhances vision. The operating microscope affords extraordinary light and magnification, giving the clinician unsurpassed vision, control, and confidence in identifying or chasing extra canals.

6. Use of the Satelec P5 piezoelectric ultrasonic unit *(Dentsply Tulsa Dental)*, as well as specially designed tips *(ProUltra Endo Tips, Dentsply Tulsa Dental)* has provided a phenomenal breakthrough for safely.

7. Sculpting away secondary dentin overlying the MBorifice. Small, specifically angled tips can easily be inserted into the handpiece, greatly enhancing control during light-touch brush-cutting action.

8. Following complete access, a 1 percent solution of Methylene Blue dye can be irrigated into the pulpal chamber, then flushed out. Dye will roadmap the anatomy by penetrating into orifices, developmental grooves, and/or fractures, enhancing diagnosis and treatment.

9. The "champagne test" is conducted within the access cavity filled with a 5.25 percent solution of sodium hypochlorite. The clinician can frequently visualize bubbles emanating from organic tissue hidden within fins, and extra orifices rising toward the occlusal table. Multiple obliquely angled radiographs preoperatively begin to demonstrate the buccal to lingual dimensions of the MBRT. The broader the root, the greater the likelihood of a second canal system. Off-angled working films with a file or gutta-percha in the MB1canal will also either reveal equal amounts of tooth structure on each side of the file, i.e.,

symmetry, or the file skewed off the longitudinal central axis of the root, strongly suggesting the presence of a second canal.

10. Bleeding emanating away from the previously cleaned and shaped MB1orifice/system and/or patient discomfort when placing files within the already extirpated MB1are a sign of residual tissue, and possible intercanal communication, suggesting a second canal harbouring pulpal tissue.
11. Anatomical familiarity, experience, and cataloguing creates a mental library of countless cases, and assists the clinician in mapping and providing successful treatment.
12. Commitment, perseverance, dedication, and mental toughness are essential elements for complete treatment.

Nonspecific methods[17]:

- **Micro-openers**: Micro-openers are flexible, stainless steel hand files attached to an ergonomically designs offset handle. They provide unobstructed vision for initially penetrating and enlarging an offshoot that divides deep within a canal.
- **Radiographs**: Well angulated images should be taken in three horizontal planes: straight-on, mesioblique and distoblique.
- **CBCT technology** represents a major advancement in diagnostics and facilitates identifying aberrant, mineralized or previously missed canals.
- **Transillumination**: A fiber optic wand may be positioned cervically so that light is directly perpendicular to the long access of the tooth. Identifying an orifice is, at times, improved by turning off any overhead light source.

Treatment

The mesiobuccal root canals has a concavity on its furcal side, and its mesial to distal dimensions are smaller palatally than buccally. The access cavity must be expanded toward the mesiobuccal line angle and mesiomarginal ridge areas, respectively, to provide optimal straightline access to the MB1 and MB2 root canal systems. Proper access will free instruments from coronal tooth structure or restorative interferences.

During early coronal enlargement of MB1 and MB2 root canals, small gates gliddens are selected and run at a slow rpm, and their shaft intentionally arced away from furcal danger while brush-cutting out of the canal. This strategy redirects and moves the preparations mesially and to the greatest bulk of dentin while concomitantly preserving maximum remaining furcal tooth structure ***(Fig5, left)***.

When identified, the optimally cleaned and shaped MB2 must be prepared more conservatively than the MB1 system due to root morphology ***(Fig 5, left)***.

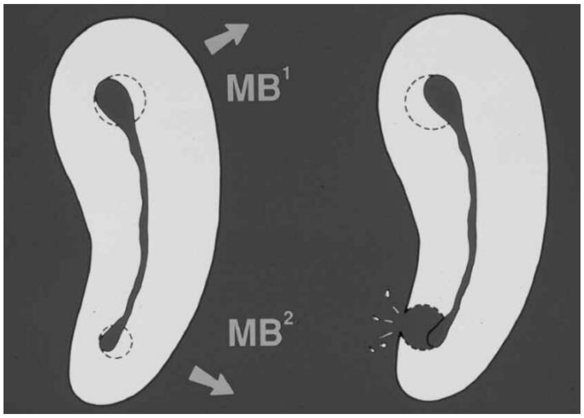

Fig5: Two coronal cross-sectional views of the MBRT. Left Graphic: Preparation procedures need to redirect the MB*[1] *and MB*[2] *canals away from furcal danger. Right Graphic: Incomplete access and improper canal preparation procedures predispose to root thinning or perforation.

Anatomically, the MB1, MB2, and related isthmus aspects of the root canal system lie closer to the external furcal side concavity, which predisposes this root to furcal thinning during cleaning and shaping procedures, increasing the potential for future fractures and/or strip perforations ***(Fig 5, right)***.

Conclusion

In order to increase the success rate of endodontically treated teeth, as much of the pulp complex should be removed as is possible. In order to accomplish this, all of the root canal orifices in a pulp chamber must be found. The only rational way to do this is by utilizing the laws of anatomy of the pulp chamber floor. The only way to utilize these laws is by having an access that permits the visualization of the pulp chamber walls meeting the floor 360 degrees around.

An endodontic referral may be prudent prior to complications or to enhance restorative dentistry. The general dentist and specialist should, therefore, work together to maximize the excellence of healthcare delivery, particularly in strategic teeth that might not be amenable to nonsurgical or surgical retreatment.

References

1. Ingle J, Bakland L. Endodontics. 6th ed. Hamilton: BC Decker; 2008.
2. Burns RC, Buchanan LS: Ch. 7, Tooth Morphology and Access Openings. In Cohen S, Burns RC, editors: *Pathways of the Pulp*, 6th ed., Mosby Yearbook Co., 1994.
3. Arnold Castellusi. Text book on Endodontics. Pg 268
4. Hess W: The anatomy of root canals of teeth of the permanent dentition. John Bale sons ans Danielsen, London, 1925
5. Pineda F, Kuutler y: Mesiodistal and buccolingual roentgenographic investigation of 7.257 root canals. *Oral surgery* 1973;36:253.
6. Smith, B.E.: Root canal morphology of maxillary first molar: the mesiobuccal root. Boston university thesis, 1977.
7. Nosonowitz, D.M., Brenner, M.R.: The major calanls of maxillary first and second molars, *N. Y. J. Dent* 1973; 43:12.
8. Acosta Vigouroux, S.A, Trugeda Bosaans, S.A.: Anatomy of pulp chamber floor of the permanenet maxillary first molar. *J. Endod.* 1978;4:214.
9. Aydos, J.H., Milano, N.F.: Morfologia interna o raiz mesiovestibular primerio molar superior permenente. *Rev. Gaucha Odontol.* 1973;21:10.

10. Stropko, J.J.: Canal morphology of maxillary molars: Clinical observations of canal configurations. *J. Endod*.1999; 25: 446.

11. Kulid, J. C., Peters, D.D.: Incidence and configuration of canal systems in mesiobuccal root of maxillary first and second molars. *J. Endod*. 1990;16:311.

12. Ruddle CJ: The Mesial-Buccal Root of the Maxillary First Molar: Treatment Considerations, *The Endodontic Report*, Fall/Winter, 1986.

13. Stropko JJ: Dental Canal Systems: An Exhaustive Clinical Canal Morphological Study, Personal Communication and to be published.

14. Ruddle CJ: Mb2 root canal systems in maxillary first molars, *Dentistry today* May 1995

15. Arnold Castellusi. Text book on Endodontics. Pg 270

16. Ruddle C.J.: Microendodontics: identification and treatment of MB2 systems. *J. Calif. Dent. Assoc*.1997; 25:313.

17. Ruddle C.J.: Identifying root canals, endodntic strategies, *Endodntic practice*, 4(6):56.

APPLICATION OF PEEK IN PROSTHODONTICS: A REVIEW

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Dr. Sharon E Fernandez

Abstract

Polyetheretherketone (PEEK) is a polymer that has many potential uses in dentistry. In last three decades, PEEK has been increasingly used as the biomaterial for orthopedic, spinal, and cranial implants. PEEK dental implants have shown equal promise and are currently being used and researched in many parts of the world. The aim of this review was to summarize the outcome of research conducted on the material for dental applications. PEEK has been explored for a number of applications for clinical dentistry, as it is a promising material for a number of removable and fixed prosthesis. PEEK dental implants have exhibited lesser stress shielding compared to titanium dental implants due to closer match of mechanical properties of PEEK and bone.

Key Words: PEEK, Implants, Prosthodontics, Polymers, Bioactivity, Osseointegration

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Introduction

Polyetheretherketone (PEEK) is a synthetic, tooth colored, high-performance thermoplastic polymer[1] with an aromatic ring and semicrystalline linear chain structures, which are connected by ether and ketone functional groups.[2] It has attractive mechanical properties, heat and chemical resistance, good dimensional stability, good biocompatibility and a low elastic modulus close to that of human bone.[3] Due to these properties PEEK can replace metallic biomaterials like titanium, Cr-Co, and zirconia in various applications. Moreover, it is also radiolucent and compatible with imaging techniques, such as computed tomography, magnetic resonance imaging and radiography.[4]

Its application has extended from the aircraft and automobile industries to biomaterials in the medical field in 1980s.[4] In 1992, PEEK was introduced for dental applications, first in the form of esthetic abutments, and later as implants and dental clasps.[5] It can also be used as an alternative rigid material for removable partial denture prosthesis frameworks and fixed dental prostheses due to its non-metallic color, low weight, and high strength.[6] PEEK can also be used as an esthetic orthodontic wire4. Due to these unique physical and mechanical properties, PEEK is a promising material for dental applications. The aim of this review is to summarize the outcome of research conducted on the material for prosthodontic applications.

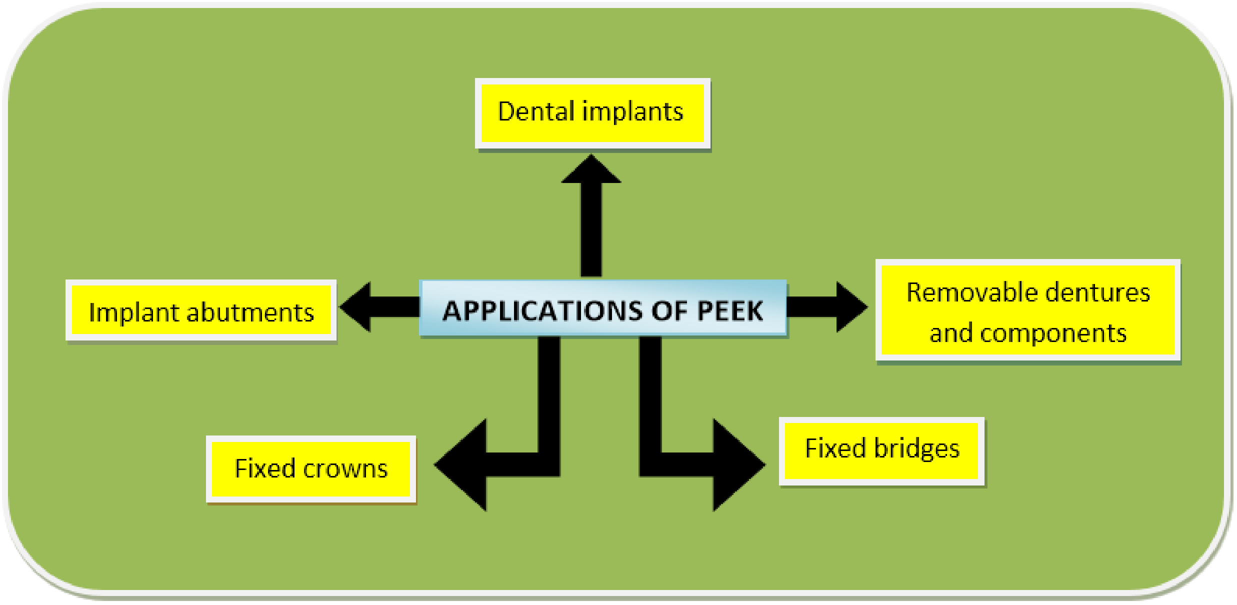

Fig 1: Applications of PEEK in Dentistry

PEEK as an implant biomaterial

Dental implants increase the quality of life for many patients with tooth loss.[7] For decades the universal choices for implant material have been titanium and its alloys. However, the search for a better material has intensified owing to some potential disadvantages of titanium, one of which was hypersensitivity to titanium.[8] Another problem was due to the gradient difference in the elastic moduli of a titanium implant and its surrounding bone. This may cause stress in the implant-bone interface during load transfer probably resulting in peri-implant bone loss. Also, titanium can cause esthetic problems due to its lack of light transmission. [7,8]

PEEK has the potential to serve as an aesthetic dental implant material. According to Wolff's Law, the bone remodels according to the load that has been applied to it. Stress shielding is the reduction in volume of the bone around an implant due to the shielding of normal loads by the implant. In its pure form, Young's modulus of PEEK is around 3.6 GPa while it is around 18 GPa in carbon-reinforced PEEK (CFR-PEEK) which is close to that of cortical bone. Hence, it has been suggested that PEEK could exhibit lesser stress-shielding, when compared to titanium. [2,9] However, PEEK has been shown to stimulate less osteoblast differentiation when compared to titanium. PEEK a bioinert material, does not possess any inherent osseoconductive properties, can be coated and blended with bioactive particles to increase the osseoconductive properties and surface roughness.[10]

The IMI implants (Intelligent Medical Implants, Pornichet, France) made of unique PEEK/ TiO2/ beta-TCP combination is named as BIOPIK. These implants are available in six fundamentally different designs; TAU, THETA, IOTA, TEX, ALPHA, and PHY for different bone volumes and densities. Most of these are one piece implants which can be modified intraorally at the time of placement. They have shown good strength, fracture resistance, and satisfactory bioinertness.[8]

Nano-structured PEEK surfaces[5,11]: The beneficial role of nanomaterials is well known for dental applications. In recent years, PEEK has also been modified at the nano-level in order to improve its bioactivity and osseoconductive properties. [11] Various methods of nanostructuring include:

(a) Plasma-spraying: Conventionally, PEEK has been coated using bioactive materials such as osseoconductive calcium hydro-xyapatite (HA) or titanium by means of ***plasma-spraying.*** In this process, particles are sprayed onto the surface of an implant through a plasma torch. The plasma melts the particles to deposit on the implant surface and producing a rough surface layer.[11]

(b) Spin-Coating with Nanohydroxyapatite is another method for coating a thin layer of nanoscale calcium hydroxyapatite on PEEK surface. In this process apatite dissolved in organic solvents is slowly dropped onto the surface of an implant rotating at high speeds. Upon heat-treatment a thin layer of HA is formed on the implants.[11]

(c) Plasma-gas etching: Here low-pressure gases are used to introduce nano-level surface roughness and functional group on the surface of PEEK implants and inducing more hydrophilicity for a better material–tissue interaction. [11]

(d) Electron-beam (e-beam) deposition involves decomposing and depositing a very thin, nano-rough layer of a material on a substrate by exposing the material to a beam of electrons. Coating PEEK with titanium using this method has shown to increase the hydrophilicity leading to enhanced cellular proliferation. An anodized nano-porous layer of e-beam coated titanium can carry immobilized bone morphogenic protein-2 (BMP-2). BMP-2 is a growth factor that has been shown to increase the bone deposition in implant sites. A PEEK implant coated with a titanium/BMP-2 coating could be an attractive aspect and a great potential for PEEK oral implantology applications.

***(e) Plasma immersion ion implantation* (PIII).** A substrate placed in plasma of particles connected to a high voltage can get coated by a thin layer of the particles of that material. Although, PEEK coated with TiO2 using PIII has shown partial activity against Staphylococcus aureus and E. coli, its antimicrobial effects against periodontal pathogens is yet to be determined.

Nano-structured PEEK surfaces produced by etching with sulfuric acid (sulfonation) and rinsing with distilled water have been observed to induce an accelerated osseointegration compared to the unmodified PEEK in vitro and in vivo. A combined effect of production of a highly nano-porous etched surface and enhanced hydrophilicity due to the presence of sulfuric acid groups could explain the improved biocompatibility of sulfonated PEEK.[12] However, it has also been seen that there is a decreased initial bone formation when sulfonated PEEK is implanted in vivo which could be explained by the presence of residual sulfuric acid on the surface.[12] This effect can be minimized by rinsing the implants with acetone to remove the residual sulfuric acid. More recent experiments have focused on using strong alkalis to introduce functional groups (OH groups) on PEEK surface which can induce formation of a biomimetic apatite layer when immersed in simulated biomimetic fluid (SBF). However, conventional biomimetic coatings can take up to 48 hours to be produced. Since debonding of bioactive coatings can be a cause of implant failures, studies need to evaluate the quality of the coating before biomimetically coated PEEK can be deemed suitable for clinical usage.[5]

PEEK implant abutments

Implant healing abutments can be constructed using PEEK. A randomized, controlled clinical trial (RCT) conducted by Koutouzis[14] et al. suggested that there is no significant difference in the bone resorption and soft tissue inflammation around PEEK and titanium abutments. Furthermore, the oral microbial flora attachment to PEEK abutments is comparable to those made of titanium, zirconia and polymethyl-methacrylate. A close match of elastic moduli of bone and PEEK surface reduces the stress shielding effects and encourage bone remodeling. Hence, PEEK could prove to be a viable alternative to titanium in constructing implant abutments.[5]

Bioactive PEEK nano-composites

In order to increase the bioactivity, bioactive inorganic particles have been incorporated to PEEK using melt-blending and compression molding techniques. Implants made of PEEK nano-composites have a number of advantages such as increased bioactivity and better mechanical properties5. Incorporating nano-sized particles like those of hydroxyfluorapatite has been suggested to impart anti-microbial properties against Streptococcus mutans, a common oral pathogen, in addition to improving osseointegration in vivo. Besides being used as implants, these bioactive nano-composites could be used as indirect intracoronal or extracoronal restorations. These restorations can have an additional advantage of being anti-bacterial as reported by Wang et al13. However, more studies are needed in order to ascertain the usage and manipulation of the composites before these composites can be used as restorative materials.[5]

PEEK as a removable prosthesis material

Dentures can be constructed by using PEEK computer-aided design and computer-aided manufacture systems. Tan-nous[15] et al has suggested that denture clasps made of PEEK have lower retentive forces compared to cobalt–chromium (Co–Cr) clasps. Another application of PEEK is the construction of a removable obturator. More studies are needed to evaluate the efficacy of PEEK obturators compared to conventional acrylic prostheses. [5]

A modified PEEK was used as an alternative material by Zoidis16 et al for the fabrication of distal extension removable dental prosthesis (RDP) frameworks. This material can be used for patients allergic to metals, or who dislike the metallic taste, the weight, and the unpleasant metal display of the denture framework and retentive clasps. This modified PEEK material, known as BioHPP, is a biocompatible, nonallergic, rigid material, with flexibility comparable to bone, high polishing and low absorption properties, low plaque affinity, and good wear resistance. BioHPP frameworks can be constructed either via CAD/CAM manufacturing or via the conventional lost wax technique. The clinical use of a BioHPP RDP framework is presented as an alternative for the treatment of a distal extension case.[16] Till now, no clinical studies or systematic reviews have focused on the use of PEEK dentures. However, owing to the superior mechanical and biological properties of PEEK, it will not be surprising if the dentures constructed from the polymer are routinely used in near future.[16]

PEEK crowns

A variety of procedures have been suggested to condition the surface of PEEK in order to facilitate its bonding with resin composite crowns. Even though air abrasion with and without silica coating creates a more wettable surface, etching with sulphuric acid[12] creates a rough and chemically altered surface which enables it to bond more effectively with hydrophobic resin composites.[17] Etching with piranha acid (H_2SO_4 and H_2O_2) and using a bonding agent have been shown to produce tensile bond strength to composite resin.[18] No significant differences were observed in the tensile bond strength of PEEK crowns and dentin abutments using air abrasion and sulphuric acid etching techniques.[19] These studies suggest that PEEK can be used under resin-composite as a coping material. Since the mechanical properties of PEEK are similar to those of dentin and enamel, PEEK could have an advantage over alloy and ceramic restorations.[1]

PEEK CAD-CAM milled fixed partial dentures

CAD-CAM designed composites and polymethylmethacrylate (PMMA) fixed dentures have superior mechanical properties compared to conventional fixed dentures. PEEK is another material that can be used an alternative to PMMA for CAD-CAM restorations. Three-unit PEEK fixed partial denture manufactured via CAD-CAM has been suggested to have a higher fracture resistance than pressed granular or pellet-shaped PEEK dentures.[20] The fracture resistance of the CAD-CAM milled PEEK fixed dentures is much higher than those of lithium disilicate glass-ceramic, alumina, zirconia. The abrasive properties of PEEK are excellent. Despite of having a significantly low elastic moduli and hardness, abrasive resistance of PEEK is competitive with metallic alloys.

Considering good abrasion resistance, mechanical attributes, and aforementioned adequate bonding to composites and teeth, a PEEK fixed partial denture would be expected to have a satisfactory survival rate. [5,6]

Conclusion

PEEK can be used for a number of applications in dentistry including dental implants because of its mechanical and physical properties being similar to bone and dentin. Increasing the bioactivity of PEEK dental implants without affecting their mechanical properties is a major challenge. PEEK is also an attractive material for producing CAD-CAM fixed and removable prosthesis owing to its superior mechanical properties compared to materials such as acrylic. Further research and clinical trials are required to explore this material and possible modifications for further dental applications.

References

1. Ramamoorthi M, Verma V, Sheikh Z. Dental Biomaterials and A Novel Composite of Zirconia and Poly Ether Ether Ketone [PEEK] for Dental Implants-Review. *Int Dent J Student's Res* 2015; 2(4):16-22.
2. Fei Chen, Hengan Ou, Bin Lu, Hui Long. A Constitutive Model of Polyetheretherketone (PEEK). *J Mech Behav Biomed Mater* 2016; 53:427-33.
3. Kurtz SM, Devine JN. PEEK biomaterials in trauma, orthopedic, and spinal implants. *Biomaterials* 2007; 28: 4845–69.
4. Pokorny D, Fulin P, Slouf M, Jahoda D, Landor I, Sosna A. Polyetheretherketone (PEEK). Part II: Application in clinical practice. *Acta Chir Orthop Traumatol Cech* 2010; 77:470–8.
5. Najeeb S, Zafar MS, Khurshid Z, Siddiqui F. Review: Applications of Polyetheretherketone (PEEK) in Oral Implantology and Prosthodontics. *J Prosthodont Res* 2016; 60:12-19.
6. Rubert SC, Calas MD, Barberá AG. Analysis of the Feeding System in the Injection Process of Peek in Fixed Partial Dentures. *Procedia Eng* 132(2015)1021 – 1028.
7. Schwitalla A, Muller W D. PEEK Dental Implants: A Review of the Literature. *J Oral Implantol* 2013; 39:743-49.
8. Marya K, Dua JS, Soniya C, Sonoo PR, Aggarwal A, Singh V. Polyetheretherketone Dental Implants: A Case for Immediate Loading. *Int J Oral Implantol Clin Res* 2011; 2(2):97-103.
9. Chen F, Gatea S, Ou H, Lu B, Long H. Fracture Characteristics of PEEK at various Stress Triaxialities. J Mech Behav Biomed Mater 2016; 64:173–86.
10. Ma R, Tang T. Review: Current Strategies to improve the Bioactivity of PEEK. *Int J Mol Sci* 2014, 15:5426-45.
11. Najeeb S, Khurshid Z, Matinlinna JP, Siddiqui F, Nassani MZ, Baroudi K. Nanomodified Peek Dental Implants: Bioactive Composites and Surface Modification—A Review. *Int J D Oral Health* 2015; 1-7.
12. Sproesser O, Schmidlin PR, Uhrenbacher J, Roos M, Gernet W, Stawarczyk B. Effect of Sulfuric Acid Etching of Polyetheretherketone on the Shear Bond Strength to Resin Cements. *J Adhes Dent*. 2014; 16(5):465-72.
13. Wang L, He S, Wu X. Polyetheretherketone/ nano-fluoro-hydroxyapatite composite with

antimicrobial activity and osseo-integration properties. *Biomaterials.* 2014; 35(25):6758-75.

14. Koutouzis T, Richardson J, Lundgren T.Comparative soft and hard tissue responses to Titanium and polymer healing abutments. *J Oral Implantol* 2007:37:174-82.

15. Tannous F, Steiner M, Shahin R, Kern M. Retensive forces and fatigue resistance of thermoplastic resin clasps. *Dent Mater* 2012; 28:273-8.

16. Zoidis P, Papathanasiou I, Polyzois G. The Use of A Modified Poly-Ether-Ether-Ketone (PEEK) as an Alternative Framework Material for Removable Dental Prostheses: A Clinical Report. *J Prosthodont* 2016; 25(7):580-84.

17. Silthampitag P, Chaijareenont P, Tattakorni K, Banjongprasert C, Takahashi H, Arksornnukit M. Effect of Surface Pretreatments on Resin Composite Bonding to PEEK. *Dent Mater J* 2016; 35(4):668-74.

18. Keul C, Liebermann A, Schmidlin PR, Roos M, Sener B, Stawarczyk B. Influence of PEEK Surface Modification on Surface Properties and Bond Strength to Veneering Resin Composites. *J Adhes Dent*. 2014; 16(4):383-92.

19. Stawarczyk B, Jordan P, Schmidlin PR, Roos M, Eichberger M, Gernet W, Keul C. PEEK Surface Treatment Effects on Tensile Bond Strength to Veneering Resins. *J Prosthet Dent*. 2014; 112(5):1278-88.

20. Stawarczyk B, Eichberger M, Uhrenbacher J, Wimmer T, Edelhoff D, Schmidlin PR. Three-unit reinforced polyetheretherketone comp-osite FDPs: Influence of fabrication method on load-bearing capacity and failure types. *Dent Mater J* 2015; 34:7-12.

TRI IMMUNOPHASIC THERAPY IN PERIODONTOLOGY

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Dr. Arya Sreedhar

Abstract

Periodontal disease describes a group of related inflammatory reactions resulting in destruction of periodontium due to upregulation of immune response and in the presence of disease causing pathogens resulting in loss of attachment and bone loss. William Hoisington has developed a new non-invasive technique known as Tri-ImmunoPhasic periodontal therapy (TIP) which allows practitioners to go up to the crest of the alveolar bone and destroy anaerobic bacteria. The methods involved are: Bone One Session Treatment, Controlling occlusal Forces, Oral Hygiene reinforcement with adjuvant modalities, Life Style modification, enhancing nutrition and Exercise. TIP can alter the pathogenesis by removing the etiological factors as well as guide the tissue for regeneration and new attachment.

Key Words: Periodontitis, Tri immunophasic therapy, TIP, BOST

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Introduction

Periodontal disease leading to destruction of periodontal ligament and the underlying alveolar bone plays a major part of the burden of oral diseases. Predominantly, gram negative anaerobic bacteria are considered to be pathogenic to dental supporting tissues.[1]

The treatment modalities includes both non-surgical (scaling, root planning, home care oral hygiene practices) and surgical (periodontal incision flap) treatment. Healing after both these treatments are slow and incomplete, also recurrence is high. Mechanical methods of subgingival debridement accomplished by thorough scaling & root planing, accompanied by oral hygiene procedures still serve as a gold standard of periodontal therapy since decades.

US periodontal therapist William Hoisington has commenced a new technique in treating periodontal disease known as Tri-Immuno Phasic periodontal therapy (TIP). TIP targets at complete healing of periodontal disease which is a relatively new concept. Most writing on the subject speaks of managing periodontal disease, acquiescing to its chronic nature, slowing it down, or reducing pockets. [2]

TIP allows practitioners to go up to the crest of the alveolar bone and destroy anaerobic bacteria – aggressive pathogens which not only causes degeneration of alveolar bone and gingiva, but also penetrate the body's circulation and contribute to systemic complications such as coronary heart disease, osteoporosis, pre term low birth weight and infertility.[2]

The development of TIP

William Hoisington has developed a new "non-invasive" technique (TIP technique) for the treatment of periodontal disease. The human body has the capacity of healing and repair by itself after any injury. TIP technique predicts the same phenomenon in periodontal disease healing and repair.

TIP has been elaborated and tested over the past several years on over 2,500 patients with remarkably consistent success in saving teeth thought lost, and limiting anaerobic bacteria generated inflammation to an acceptable minimum (Hoisington et al 2005).[3]

Rationale

The Tri-ImmunoPhasic therapy, (TIP), assumes that the body is capable of healing periodontal disease just as other forms of repair. Damaged alveolar bone can heal like any other fractured bones if all the right conditions are met.[4]

Immune system phases

TIP periodontal therapy influence the local and host factors which modify periodontal disease progression and improve the condition for healing by aiding the body in all three immune phases. The three immune phases are:

- vigilant readiness
- defense phase
- repair and regeneration

TIP sets up all the conditions where the body can get out of the defensive phase against bacteria and other microorganisms and enter into a regeneration phase to heal back a new attachment.

TIP-periodontal therapy methods include:

- *Bone One Session Treatment(BOST)*
- *Controlling biting forces*
- *New oral hygiene routine*
- *Lifestyle, nutrition and exercise*

1. Bone One Session Treatment (BOST)

Bone one session treatment (BOST) is an aerobic treatment that eliminates periodontal disease in the deepest pockets and supporting alveolar bone. The deep cleaning, aerobic treatment combats the disease by tackling the source of the infection under the gums. The whole mouth is treated in one session of about 4 hours to limit reinfection. The use of antibiotics is greatly reduced.

It starts with a simple DNA test to identify the exact form of bacteria involved and their quantities.[5] A DNA test is done immediately before and after treatment. The results showed that 99% of the bacteria could be removed with the BOST gum treatment.[5]

BOST minimizes damage to the gingiva, bone, and periodontal apparatus during treatment. It uses technique called "Stretch flap" to gain access to deeper structures. "Stretch Flap" allows access all the way down to the deep areas of the roots and the surface of the bone without incisions. This is done by taking advantage of the elasticity of the gingiva to intentionally stretch it open without cutting it. Then removal of local obstacles that prevent healing and contaminating roots and surfaces of the bone is done.

Stretch flap technique: [4]

First step: In this step universal 4R-4L curette is inserted inside the sulcus, where working end facing towards tooth surface and blunt non-working end facing tissue. A slight pressure is applied on tissue to begin stretching while removing superficial plaque and calculus ***(Fig 1).***

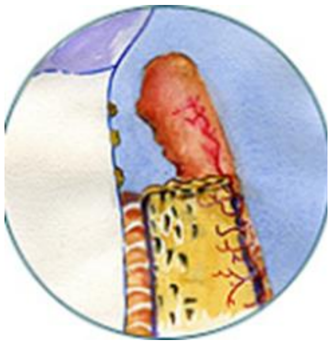

Fig 1:The sulcular area

Second step: The direction changes to a circumferential motion starting at the corner to mobilize the tissue and avoid pulling the papilla free and in essence creating an incisional flap ***(Fig 2).***

Fig 2: Application of curette

Third step*:** With the tip of the curette advancing, first the surface of the bone is instrumented to remove attached granulation tissue and expose and plasty the bone porosities which help physically to remove microorganism and toxins in the pockets through the fresh bleeding ***(Fig 3).

Fig 3: Plasty done

Healing after BOST

Sutures are not necessary. That saves time and allows the new hygiene routine to start the next day.The patient uses a tool calledperioaid to disrupt and prevent the pellicle formation.

Stage one: *Movement of stem cells*

The stem cells can move along it and up the root surfaces at the rate of 0.5mm per day for eight days and thicken the layer on the clot. To permit this activity it is also important to keep the epithelial attachment away from the roots. This is done with the oral hygiene technique that keeps the pocket open and also inhibits the reformation of the sticky layer ***(Fig 4).***

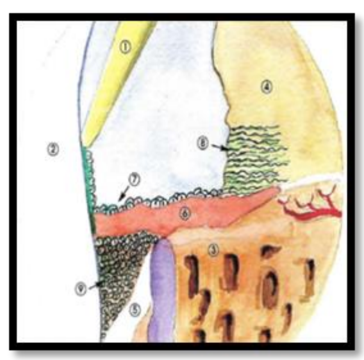

Fig 4: Movement of stem cells

Stage two: *Maturation of the attachment*

As healing time increases, the pockets gradually fill from the bottom with very dense, partially mineralized connective tissue in a time period of 4 to 6 weeks and finally it will become acellular ***(Fig 5).***

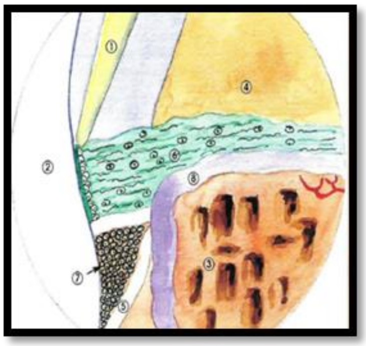

Fig 5: Maturation of the attachment

Stage three: *MAC attachment completed*

Partially mineralized connective tissue finally becomes acellular. Once the new mineralized acellular connective tissue (MAC) attachment is in place is in about one month, the bone naturally heals under it.

Stage four: *Bone maturation*

A new dense layer of cortical bone forms over the healed inner (cancellous) bone in about eight more months ***(Fig 6).***

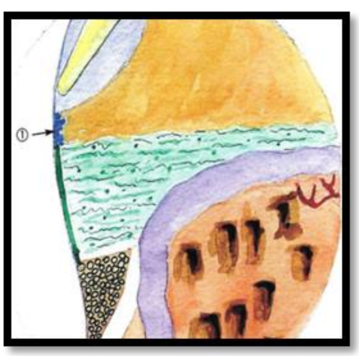

Fig 6: Bone maturation

2. Controlling biting forces and saving mobile teeth

The occlusal aspect is considered with priority during treatment in order to limit occlusal trauma. Splinting is also done to stabilize mobile teeth. Even if the literature shows that occlusal trauma by itself cannot be the etiology of periodontal disease, each clinician will admit that addressing these problems with selective grinding or splinting improves patient comfort, reduces fear of losing loose teeth, and makes teeth easier to treat. Often esthetic improvements can be made simultaneously.

Treatment modalities like enameloplasty, coronoplasty and occlusal splint are given in order to redistribute the forces among all the teeth.

3. New oral hygiene routine

Along with Brushing, flossing, and other conventional methods of dental hygiene, Aerobic Oral Hygiene Kit (PERIO-AID) that is created specifically to clean the area under gums and eliminate the disease-causing bacteria all the way down to the attachment and into root concavities where brush and floss does not reach, is used.

Perio-Aid contains specifically designed and treated green tips called "aeros". The idea is to reduce biofilm and aerate the subgingival areas all the way to the attachment and in the grooves and furcations. The patients are instructed to listen for the squeaky clean surface, look that no blood is on the aero tip and that the attachment feels firm ***(Fig 7).***

Use of perio-aid stops the suction cup like cells called epithelium on the inner tissue wall from attaching to the roots. The epithelial cell's job is to seal things up quickly. Their fast but weak connection

(WC), would shut down slower healing from the bottom up.

Fig 7:Perio-Aid with the aeros tip

4. Life style, nutrition and exercise

- Eat a balanced diet which includes plenty of protein and a moderate intake of unsaturated fat
- Eat regular meals
- Avoid excessive sugar and snacks
- Avoid granular food like nuts, seeds, chips, whole grain breads etc. for a couple weeks while the tissue seals up,
- Increase your intake of vitamins and minerals. Vitamin C and zinc are the most important.
- Avoid smoking. Smoking promotes anaerobic conditions, slows down healing, reduces circulation, and depresses certain immune cells
- Exercise regularly. Exercise increases circulation to bring in building blocks and oxygen to the tissues as well as the vitamins and minerals that permit proper uptake.

Who should get the treatment?

- Patients that are concerned about esthetics
- Patients that do not respond well to the initial periodontal therapy
- Everybody who has radiographically showing bone resorption
- Motivated patients

Recovery process of TIP (Fig8 &9)

Day 1: Bost Treatment
Day 2: Patient Restart Oral Hygiene
Day 3: Bleeding Stop
Day 4: Pockets Start To Fill In
Day 5: Inflammation Continues To Receed
Day8: Pocket Sealing Up
Day 14: Resume Normal Chewing
Day 15: Check Up
Day 30: Pockets Have Filled
Day 35: Esthetics Restoration Can Start.
Day45: Bone Is Beginning To Heal
3 Months: Check –Up
9 Months: Bone Completely Healed

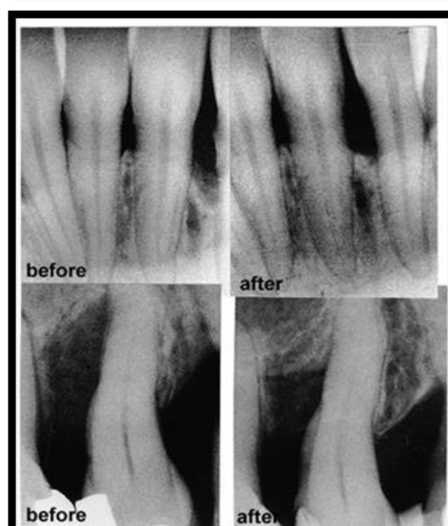

Fig 8&9: IOPA Xrays showing the success of TIP

Concepts that separate BOST from traditional periodontal therapy

- BOST aims to minimize damage to the gingiva, bone, and attachment during the course of the treatment. The micro-surgery procedure is non-invasive; protecting the tissue that has not been damaged by the periodontal disease.
- BOST creates a strong attachment, which is necessary to heal the gums and bone and prevent further outbreaks of periodontal disease.
- The recovery process after BOST is quick and easy.
- BOST is performed in a single session of treatment.

Advantages of TIP/BOST

- Personalised treatment by identifying causative agent
- Non-invasive treatment
- No damage to gingiva
- Less discomfort during or after the treatment.
- Long-term success.
- Quick (1/2 day appointment) single session.
- Helps improve aesthetics / oral health / general health / function / confidence.
- Less prone to reinfection
- Great alternative to implants.
- Cost-effective solution.

Conclusion

This treatment brings a logical and effective aid to solve daily clinical problems in complex cases, offering many advantages for both patients and practitioners.TIP sets up all the conditions where the body can get out of the defensive phase against bacteria and other microorganisms and into a regeneration phase to heal back a new attachment.

TIP is a simple, non-invasive technique which demands more attention as it has appears to be a promising future of periodontal treatment.

References

1. Stamatova I, Meurman JH; Meurman: Probiotics and periodontal disease. *Periodontology 2000*, 2009; 51(1): 141–51.
2. William Hoisington New developments in perio: Tri-Immuno-Phasic therapy. *Preventive Dentistry.*, 2006; 1(2): 30-4.
3. Dr.William HOISINGTON, Pierre DOGUOU, Dr.Yulia GREBNEVA, Dr. Didier HUGOT. Le TraitementParodontal Initial a l'aide du Bone One Session Treatment (BOST). *Journal Implantologie, Revue Trimestrielle*, 2005. Nice, France Feb 2005. ISSN 1763-1033.
4. Y. Pradeep Kumar, V. Kalaivani, K. Rajapandian,Maharshi Malakar. Tri-immuno phasic periodontal therapy . *World Journal of Pharmaceutical Research* 2016 .volume 5, Issue 9, 356-60.
5. R Arpita, JL Swetha, MR Babu, R Sudhir. Recent Trends in Non-Surgical Periodontal Care for the General Dentist - A Review *Bangladesh Journal of Dental Research & Education* 2014;4(2)-12-16.

6. Ashimoto A, Chen C, Bakker I, Slots J. Polymerase chain reaction detection of 8 putative periodontal pathogens in subgingival plaque of gingivitis and advanced periodontitis lesions. *Oral Microbiol Immunol*; 1996;11(4):266-73

7. Beikler T, Prior K, Ehmke B, Flemmig TF. Specific antibiotics in the treatment of periodontitis - a proposed strategy. *J Periodontol;*2004; 75(1):169-75

AWARDS & ACHIEVEMENTS

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DENTAL TECHNIQUE

Fabrication of postsurgical auricle separator stent in reconstruction of the ear

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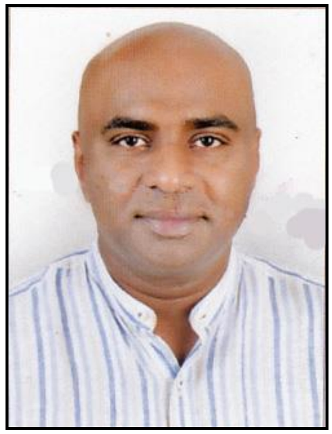
ABSTRACT

A natural appearing ear with appropriate projection from the head remains a great challenge in the reconstruction of the ear. Surgical and prosthetic means have been addressed in the management of patients with microtia, with each carrying its own merits and demerits. Lack of adequate projection of the ear and adhesion of tissues are some common complications of reconstructive surgery that can adversely affect the treatment outcome. This article describes a technique for the fabrication of a postsurgical stent to prevent adhesion of the surgically reconstructed ear to the underlying tissues. This also enhances the projection of the ear from the head. (J Prosthet Dent 2017;117:566-568)



Dr. Binu Purushothaman has been nominated to Dental Council of India by the Government of Kerala as DCI Member.

Dr. Sahron E Fernandez and Dr. Dhanya Preman T won the first prize for paper presentation in the case report session for their paper titled "Plumping technique to restore facial symmetry in a completely edentulous facial paralysis patient" at the 19th Indian Prosthodontic Society (IPS) PG Convention held at Seema Dental College, Rishikesh on 17th July 2017.