Original Research

PRESENCE OF ISTHMI IN MESIOBUCCAL ROOT OF MAXILLARY FIRST MOLAR: A CONE BEAM COMPUTED TOMOGRAPHY STUDY

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Abstract

Background- Various irregularities in root canal system are the norm amongst these Isthmus are one of the predominant feature that complicates the root canal treatment.

Methods- CBCT scans of 60 patients were selected on the basis of predetermined inclusion and exclusion criteria making a total of 120 right and left Maxillary permanent first Molar teeth. Both the maxillary first molars were evaluated on the basis of CBCT scan for presence or absence of isthmi. Each tooth was evaluated in the axial plane with an interval and thickness of 1mm from the orifice to apex & vice versa to detect presence of isthmus.

Results- On the basis of scan, overall prevalence of isthmi was found to be 88.3%, in the mesiobuccal root of Maxillary First Molar. Highest frequency of RCI was observed (38%) in the cervical third extending up to middle third whereas, lowest was seen in apical third region (7%).

Conclusion- On the basis of results obtained in this study it can be concluded that isthmus are found most commonly in cervical and middle third region. CBCT is an effective technique for detecting and locating the isthmus.

Key words- Cone beam computed tomography, Root canal isthmus, Maxillary first molar.

INTRODUCTION

The success of the root canal treatment is influenced by the anatomy of root canal system. Complexity of the root canal could render the treatment difficult, affecting cleaning, shaping, and obturation. Inadequately cleaned canals may lead to periapical inflammatory responses as well as destruction of bone, indicating a need for periapical surgery for the removal of lesion along with the contaminated area of the apex.[1] One such anatomical irregularity in molars is the area of isthmus, which can act as a reservoir for necrotic debris, tissue remnants, organic matter and microorganisms.[2]

According to Vertucci, an isthmus is defined as a narrow anatomical part or passage connecting two larger structures or cavities, which can be considered as a lateral connection between canals of the same root or classified as an anastomosis.[3] Isthmus can also be considered as complete and partial, former is a continuous connection between the two main canals of the same root, while later is an incomplete connection with one or more openings between two main canals.[4]

In an effort to overcome these difficulties found during endodontic therapy several invasive and non-invasive method have been applied so far to examine the morphology of the root canals. These include periapical radiography, vertical and transversal sectioning, decalcification, stereomicroscope, surgical microscope, dissecting microscope, scanning electron microscope. Among these one of the most regularly used imaging method is Periapical radiography. However because of certain limitations its application in the outcomes of RCT is limited.[7-18]It might be illusory to evaluate the three-dimensional macro configuration of the root canal system by an imaging examination that shows the anatomical structures in only two dimensions. Therefore, incorporation of new technological resources, such as cone beam computed tomography (CBCT) and micro-computed tomography (μCT) aid in the study of internal root canal anatomy. [8,10,12,17-18]

Therefore, this study was carried out to determine the presence of isthmi at different locations in mesiobuccal root of maxillary first permanent molar using cone beam computed tomography.

MATERIALS AND METHODOLOGY

The databases of patients with different diagnoses who were referred to the dental radiology service of private clinics in Delhi were searched to select CBCT scans of 60 patients making a total of 120 right and left Maxillary permanent first Molar teeth of via CARESTREAM CS 3D Imaging software (version 3.3.11.0) & HP Computer with Intel(R) Core(TM) based processor .[19]

CBCT images of permanent maxillary first Molar, free of defect, within age group of 21 to 30 years, with fully formed apex were included. Images with high-resolution were taken up to ensure that the analyses was accurate. Images with extensive coronal restorations, internal or external resorption, calcified root canals, poor quality scans, post and crowns were excluded from the study.

The Mesiobuccal root of maxillary permanent first molar teeth was focused to view the scans in different planes (sagittal, coronal, and axial) at 0.1-mm thickness. Axial scanning of 0.1-mm/0.1-mm slices moved from coronal to apical and from apical to coronal region. Improved visualization and valuable information was provided for identification of frequency and position of Root canal isthmi (RCI). (Fig.1 & 2)[19]The presence or absence of RCI in each tooth was analyzed; using the map reading strategy by Pecora et al in 2013, examination followed longitudinally in the axial plane from the pulp orifice to the root apex. Images were analyzed by 2 observers (one Endodontist and one Radiologist).When differences were observed, a consensus was reached, discussing the image.[8, 19] On the basis of presence and absence of complete isthmus in each tooth, the length of each root was divided into 3 equal sections and the findings were recorded into 6 categories according to the site of RCI beginning and end:

1. Both in the cervical third (CT-CT)

2. Begin in the cervical third and end

in the middle third (CT-MT)

3. Begin in the cervical third and end

in the apical third (CT-AT)

4. Both in the middle third (MT-MT)

5. Begin in the middle third and end

in the apical third (MT-AT)

6. Both in the apical third (AT-AT)

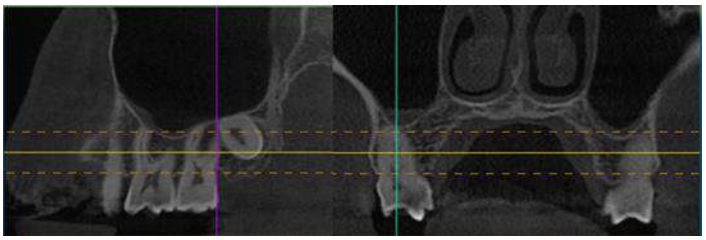

Fig. 1

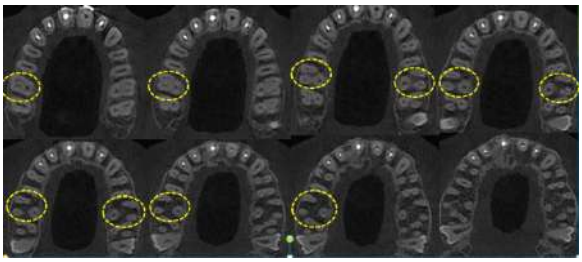

Fig. 2

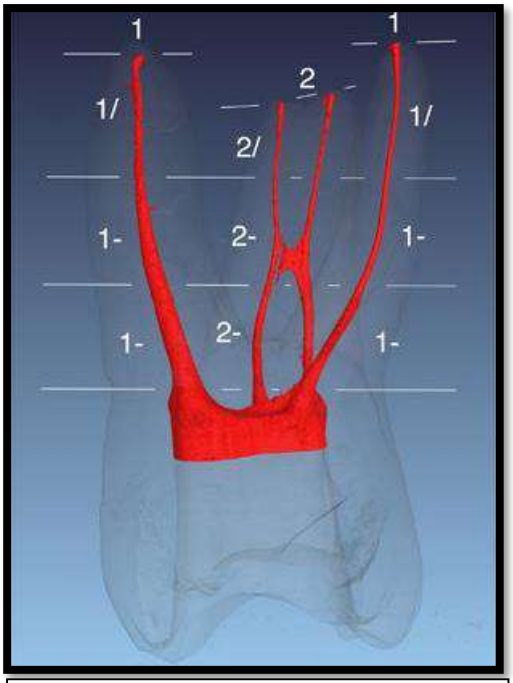

Fig. 3

The frequency distribution of the different types of isthmus was analyzed according to the level of root and evaluated by the chi-square test. Significance level was set at $\alpha=0.05$. Statistical analysis of data was performed using the Statistical Package for Social Sciences, version 20.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.000[a]	25	.224
Likelihood Ratio	21.501	25	.664
Linear-by-Linear Association	5.000	1	.025
N of Valid Cases	6		

Table. 1

RESULTS

Total No. of teeth	Presence of Isthmus	No Isthmus
120	93	27

Table. 2

With respect to the beginning and end points of isthmus, the frequency of RCI that begin in the cervical third up to middle third was 38%. The lowest frequency was observed in the apical third region which was 7%. (Table 2)

	FREQUENCY	**PERCENTAGE**
CT-CT	14	11.7
CT-MT	38	31.7
CT-AT	9	7.5
MT-MT	17	14.2
MT-AT	18	15
AT-AT	7	5.8

Table. 3

Out of 120 teeth, isthmi was found in 93 teeth, in 27 teeth no isthmus was present. Thus, the overall prevalence of isthmi was 88.3% in the mesiobuccal root of Maxillary First Molar.

Discussion

One of the common anatomic irregularities found in root canal space of permanent teeth is the presence of root canal isthmi, exception for this finding is maxillary anterior teeth. Numerous methods have been used to evaluate RCIs which include periapical radiography, vertical and transversal sectioning, clearing and staining, stereomicroscopy, surgical microscopy, dissecting microscopy, plastic casting, scanning electronic microscopy, CBCT, and MCT. Satisfactory visualization of RCIs has been achieved by CBCT images, and their use in association with a longitudinal map-reading strategy to identify isthmi. [8,14,19]

Isthmus formation occurs when an individual root projection is incapable to close itself, forming a constriction. Normally during formation of distobuccal root of maxillary molar, there is complete fusion of approximated root projections to form single root with one root canal. Isthmus is formed when an individual root projection is unable to close itself, forming a constriction. Isthmus can be present along the entire length of the root when there is no fusion, leading to a large ribbon shaped canal. It is a most common finding in the distal root of mandibular first molars and maxillary second premolars.

In our study, scans were obtained and examined from pulp orifice to root apex & vice versa. Incidence of canal isthmus in mesiobuccal (MB) root of the maxillary first permanent molar was 88.3%, whereas incidence for the same has been reported to 33.1% by Weller et al (1995), 93% by Sin H. et al (2017) & Estrela et al (2015), 52% by vertucci,[3,4,2,19] he also reported that 75% of the anastomoses were located in the middle and 15% were in the apical third of the root. A higher incidence of isthmus in the MB of upper first molar & mesial root of lower first molar was reported to be at 3-5 mm from apex by Tiexeria et al (2003).[6]

The reported incidence rate in the current study was lower than their studies, which could be due to the examination of only continuous connection between two canals in the same root; in other words,only complete isthmi were studied.Teixeira et al. (2005), found that the prevalence of isthmi was examined via cross sectional slicing at specific distances from the apex. Highest prevalence was found by the isthmi extending from cervical third to middle third i.e. 31.7% with the lowest at apical third i.e. 5.7%. Weller et al. (1995) observed that the prevalence of complete isthmus in the mesiobuccal roots of the maxillary first molars was 5.0% to 14.8% (1-6 mm of level from apex), and partial isthmus was 23.1 to 88%.[4]

Jung et al. (2005) found a lower prevalence of partial isthmus (2.6-15.8%), while in contrast to our study where prevalence of isthmi in apical third was 5.8%, Mannocci et al. (2005) found a higher frequency of isthmus at 3 mm (50.25%) of level from apex than 1 mm (17.24%).[7,12]

Several factors may be responsible for the justification of variations in the frequency of RCI found in our study. These could be because of different method of estimation, sample size, definition of isthmus, differences between RCI definitions, and tooth age.[19] While determining the frequency of isthmi in an ex-vivo study the factors that cannot be controlled are patient's age, sex and ethnicity, though age & gender of the patient can still be controlled in vivo studies. The frequency of Root canal isthmi reported in most of literature studies has been found in serial static and cross-sectional slices. Therefore, a consideration in variability of human tooth anatomy described in the literature should be taken into account before initiation of any root canal treatment. The frequency of number of roots, canals, apical foramina, isthmi, ramifications and canal shapes may not match any perfect standard.

In our study, the isthmuses were detected in all thirds of the root canals. The frequency of isthmus was found higher in the cervical and middle third. Similarly, Estrela et al & Pecora et al detected highest frequency of isthmus in these locations, whereas in contrast Haghanifar (2017) found highest incidence of isthmus in middle third region. The reason for these findings can be attributed to the fact that prevalence and site of isthmi vary among human populations dependent on race, geographical region, age, gender, research methodology, sample size and the type of isthmus.[2,8,19]

CONCLUSION

On the basis of results obtained in this study it can be concluded that isthmus are found most commonly in cervical third and middle region with a percentage of 38%. CBCT is an effective technique for detecting and locating the isthmus.

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Review Article

PAOO: A REVIEW

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Abstract

With a rising number of older patients approaching to the orthodontic clinic, the orthodontist is frequently looking for ways to shorten treatment duration, esthetics. Periodontal accelerated osteogenic orthodontics (PAOO) is a surgical approach that comprises selective alveolar corticotomy, particulate bone grafting, and the application of orthodontic forces. This technique is hypothetically based on the bone healing pattern known as regional acceleratory phenomenon (RAP). PAOO result in an enhancing alveolar bone width, shorter treatment duration, increased post treatment stability, and decreased apical root resorption. This article describes history, biology, surgical techniques, indications, contraindications and complications of PAOO.

Key words: Periodontics, corticotomy, osteogenic, orthodontics.

INTRODUCTION

Periodontium considered as supporting structure of teeth, comprises of gingiva, periodontal ligament, cementum and bone. An anatomical unit is formed by supporting bone which surrounds the alveolar wall. The alveolar bone consists the cortical plates and the septa. The teeth and their supporting structures persist vigorous after the eruption period, indicates adaptation mechanisms maintaining the support and the integrity of the periodontium, which renews the tissues through progenitor cells. The orthodontic treatment is being pursued by an increasing number of adult patients.[1] The continuity of treatment, considerations regarding dento-facial aesthetics, and various appliances that can be used are the different requirements of these patients. As compared to children, in adults growth is an almost insignificant factor, where there is increasing chance of occuring hyalinization during treatment. As in older patients teeth restricted in non-flexible alveolar bone so they are more prone to periodontal complications.[2]

Upon the advent of corticotomy-assisted orthodontic treatment (CAOT), several hindrances in orthodontics have been removed, and it has offered solutions in the adult's orthodontic treatment. The newer approach i.e periodontally accelerated osteogenic orthodontics (PAOO) explained here which maximizes alveolar volume after orthodontic treatment. This technique includes selective decortications facilitated orthodontic technique followed by bone augmentation. There are several advantages of such procedure which includes reduced treatment duration, simplify expansion, ease eruption of impacted teeth, an increase orthodontic strength after treatment. The above approach increases rate of tooth movement in lesser time which is needed for conventional orthodontic treatment.[3]

HISTORICAL PERSPECTIVE:

Surgically assisted orthodontic tooth movement has been used since the 1800's. "Luxation, or the immediate method in the treatment of irregular teeth" introduced by Cunningham in 1893 at the International Dental Congress in Chicago. LC Bryan in 1893 described corticotomy, which is described as enucleation technique where only cortical bone is modified mechanically to facilitate differential tooth movement and also published his work in the textbook named "Orthodontia: Malposition of the Human Teeth, Its Prevention and Remedy" by SH Guiliford. In 1931, Bichlmayr has come up with a surgical approach for expeditious improvement of extreme maxillary protrusion with orthodontic appliances. Firstly, to lessen the volume of bone, wedges of bone has to be removed through which the maxillary anterior roots prefered to be retracted.[4] In 1959, Kole broadened his ideas space

reduction, rectifying cross bite etc. However, his publication; performed as platform for advancement of this approach.

In Kole's belief, the continuance and increased density of bone has provided the maximum support to tooth movement. His theory depicts intruding stability of cortical bone, by creating and moving blocks of bone blocks where teeth were inserted and mentioned as "bony block movement". Kole's, technique includes full thickness flap reflection, followed by perforation of interdental through the cortical bone and narrowly piercing the medullary bone (corticotomy). In osteotomy, the subapical horizontal cuts connecting the interdental cuts and penetrating to extent of alveolus . But due to its aggressive nature, it was later put an end by many orthodontists'.[4]

An experiment on dog conducted by Duker et al in 1975, which indicates about increased tooth movement achieved by orthodontic appliances through deblitating the bone.[5] A association in rigidness of bone corticotomy and the strength of healing response, led to expedite bone rate at surgical sitewq, was first reported by Harold Frost, an orthopaedist in 1983. This was nominated as "Regional Acceleratory Phenomenon (RAP)". He briefly explained, regional response of tissues to virulent stimuli, identified by increasing normal processes. It has been noticed that in maxilla and mandible, osteoclastic activity and ridge resorption maximizes, followed by implementation of a bony insult.[6]

The concept of "Bony block movement was confronted by Dr. Thomas Wilcko (Periodontist) and Dr. William Wilcko (Orthodontist) in 1995, of Erie, PA.[7] In 2001, the findings of Wilcko brothers were published by them in which they had amended the bony block approach and performed two cases of crowding along with selective decortication. They described in an assessment of corticotomized patients, using hospital based high resolution CT scan imaging, that the small outlined blocks of bone lost their structural integrity due to an evident demineralization of the alveolar housing over the root prominences. Closer to the circumscribing corticotomy this apparent demineralization takes place and cuts both on the pressure side of the teeth and on the tension side of the teeth. RAP is preferred over "bony block movement" as they are associated with the initial alveolar demineralization and following remineralization was accordant with the cascading physiologic events.[8]

The corticotomy assisted orthodontic technique further modified by Wilcko et al in 2008 with the inclusion of bone augmentation and mentioned the technique initially as Accelerated Osteogenic Orthodontics (AOO) and more recently as Periodontally Accelerated Osteogenic Orthodontics (PAOO) which afterward patented as "Wilckodontics" based on the developing conception of Wilcko brothers.[9] This technique has the combination of fixed orthodontic appliances, labial and palatal/lingual corticotomies and bone grafting. After 2 weeks tooth movement was initiated subsequently by activation of the fixed orthodontic appliance. This combined active surgical orthodontic treatment is the most important feature of this technique which reduces the duration of treatment to one third that of traditional treatment and allowed more foreseeable treatment in older patients.[10]

Physiological bone remodeling:

The physiological process comprising osteoclast mediated bone resorption coupled with osteoblast-mediated bone formation known as bone remodeling or bone turnover.[11] The eventual bone mass at the bone remodelling site determined by the stability between osteoblast and osteoclast. Osteoclasts emerges from the macrophage lineage of hematopoietic stem cells in the bone marrow, whereas osteoblasts derive from mesenchymal cells within the stroma of bone marrow.[11, 12] The differentiation, maturation, and functional activity of osteoclasts are regulated and mediated by various biological agents comprising the receptor activator of nuclear factor jB (RANK)/RANK ligand/ osteoprotegerin signaling pathways, macrophage colony-stimulating factor, parathyroid hormone (PTH), estrogen, and various cytokines .[13, 14]

In contrast, bone morphogenic proteins (BMPs) and the Wnt/b-catenin signaling pathways activates the osteogenic transcription factors (e.g., RUNX2 and osterix), which is compelled by the differentiation and maturation of osteoblasts. Proteins such as bone sialoprotein, osteocalcin, alkaline phosphatase, and collagen type I plays a crucial role in formation of bone; and are incorporated by osteoblasts in the local microenvironment. The functional activity of

osteoblasts are stabilized by PTH, 1,25dihydroxyvitamin D, and growth factors like platelet-derived growth factor (PDGF), transforming growth factor b (TGF-b), and fibroblast growth factors (FGFs).[13] Osteocytes interfaced with osteoblasts along with osteocytes through gap junctions including the ends of their dendritic processes in three-dimensional lacunocanalicular network.[11] A gap junction is a channel that connects the two adjacent cytoplasm of cells, which permits the transit of ions and small signaling molecules. The mechanical, chemical and electrical factors synchronizes the functional activity of a gap junction.[11] The assembly of ECM proteins and ECM remodelling are balanced by cells through focal adhesions; importantly, the cell adhesion, migration, proliferation, differentiation, apoptosis, and biochemical cellular responses can regulated by ECM.[15] The various strains persuaded by firm ECM at the cellular focal adhesion domain, thus resulting in adhesion between strong cell and ECM.

Physiological bone remodeling sets about with osteoclastic activity. It is characterized by the degradation of inorganic crystalline apatite and organic component which also releases biologically active agents (e.g., BMPs, FGFs, and TGF-b) into the local microenvironment from the organic matrix of the resorbed bone.[11, 16]

Eventually, the proliferation and differentiation of osteoblast precursors mediated these biological agents, along with the secretion of non-collagenous proteins and collagen fibers, to form an organized matrix followed by mineralization, consequently forming new bone.[11, 16]

Biomechanics of Wilckodontics

Regional acceleratory Phenomenon (RAP):

Herald Frost, an orthopedist admited that surgical wounding of osseous tissue causes evident change activity close to the injury site. He concurrently entitled this cascade of physiologic healing events –"The Regional acceleratory phenomenon" (RAP).[17, 18] In this event, tissue rejuvenate rapidly than normal due to local response of tissues to noxious stimuli.[6] The duration, size, and intensity with the magnitude of the stimulus are varied directly in this response. Depending upon the category of tissue, RAP usually withstands for about four months in bone. RAP brings about bone healing to occur 10-50 times faster than normal bone turnover.[19] In rat tibia, the healing phases of RAP has been studied. Initially there is an genesis stage of woven bone, which starts in the periosteal area and then increases to medullary bone, reaching its maximum thickness on day seven. The fundamental component of RAP is a cortical bridge of woven bone which provides strength of bone after injury. From day seven, this woven bone experiences remodeling to lamellar bone, but in the medullary area, woven bone results in resorption, that means transitory local osteopenia. It has been noticed that after initiation of the new formation of cortical bone, medullary bone needs to be reorganized and restore and modify to the restructure of cortical integrity (three weeks in rats). In context of systemic release of humoral factors there is a systemic acceleratory phenomenon (SAP) of osteogenesis.[19]

During surgical injury, RAP starts within a few days, usually peaks at 1-2 months, and recede completely in 6 to 24 months.[18] In healthy tissues, RAP decreases density of regional bone (osteopenia) where as the volume of bone matrix remains sustained.[17] RAP is maximal, when tooth movement is combined with selective decortication.[19, 20] Wilcko et al. in 2001, reevaluated the novel technique of bony block movement with variations. He completed cases with severely crowded dental arches, and contemplated that patients who underwent selective decortications with the dynamics of physiologic tooth movement might be due to a demineralization-remineralization process peferably than bony block movement. They recommended that this process would exhibit as role of RAP that include bony tissue after being revealed to corticotomy and during active tooth movement.[3]

PRINCIPLE OF PAOO

Following corticotomy, RAP corroborates tissue rearrangement and healing by way of a transient burst of localized bone remodeling. At injury site, there is an increase in osteoclastic, osteoblastic activity, and levels of inflammatory markers. Duration of RAP depends on the type of tissue, and usually withstands for 4 months. This event give rise to healing occurs 10– 50 times faster than normal bone turnover.[19] This relative transient osteopenia in alveolar bone is due to surgical wounding.[21] The biomechanical resistance is reduced by this phenomenon and

through trabecular bone expeditious tooth movement takes place. This transient osteopenia phase can be extended with orthodontic appliance. This is why at every 2 weeks, it is very important to alter the orthodontic appliance.[22]

INDICATIONS

A. Reduce treatment duration and settle crowding.

B. Enable retraction of canine after premolar extraction.

C. Increase orthodontic stability after treatment

D. Ease the impacted teeth eruption

E. Simplify orthodontic expansion

F. Enable intrusion of molars and open bite correction

CONTRAINDICATIONS

A. Patients with chronic periodontitis.

B. Patients with poorly treated endodontic problems.

C. Patients on long term medications which decreases bone metabolism, such as bisphosphanate, steroid therapy and NSAIDs. NSAIDs reduced osteoclastic activity and disturbing bone remodeling due to prostaglandin inhibition.

COMPLICATIONS

PAOO contemplated as a novel approach than osteotomy-assisted orthodontics, to date several reports are evaluated about destructive effects to the periodontium after corticotomy, it has also been noticed about mild loss of interdental bone and attached gingiva, with short interdental distance.[8] After thorough corticotomies, subcutaneous hematomas of the face and the neck, post-operative discomfort has been noted.[23]

Liou et al. indicated about normal pulp vitality after rapid tooth movement at a rate of 1.2 mm per week in an animal study. It has been evaluated about correlation between resorption of root and duration of the applied force and believed that resorption of root is anticipated with orthodontic tooth movement. A correlation between resorption of root and duration of the applied force was evaluated. The risk of root resorption reduced by treatment duration of PAOO.[24] In beagles Ren et al. reported that following corticotomy, rapid tooth movement without any associated resorption of root.[25] Moon et al evaluated adequate intrusion of maxillary molar (3.0 mm in two months) by using corticotomy including skeletal anchorage system.[26] Advance research will enliven the avtivity of root resorption on the long-term effect of PAOO.

PATIENT SELECTION CRITERIA

Patient selection plays a key role for success of the procedure. Both the orthodontist and the periodontist should agreed for the requirement of corticotomy, treatment plan and the extent and location of the decortication cuts.[27] The age choice for PAOO can be from 11 years to 77 years of age due to healthy periodontium.[3] Following cases are contraindicated for this procedure**:**

1. Patients with chronic periodontitis is not a candidate for PAOO.

2. Patients having alveolar bone loss, root resorptions should not be considered for PAOO .

3. Patients on having regular doses NSAIDs therapy (due to rheumatoid arthritis) may not be suitable for PAOO.

4. Patient having bimaxillary protrusion with a gummy smile should not be considered for PAOO. Segmental osteotomy is a preferred choice.

5. PAOO should not be used as an alternative for surgically assisted palatal expansion in treatment of cross bite .

6. PAOO is not applicable for Class III condition.

DISCUSSION

Technique of Periodontally Accelerated Osteogenic Orthodontics

Under local anesthesia, crevicular incision is given buccally and lingually extending up to two teeth beyond the primary area to be treated after suitable case selection and placement of orthodontic bracket (before 1 week of surgery).[28]

Flap Full-thickness: flap is raised labially and lingually in the coronal area, whereas a partial-thickness flap is reflected to allow mobility of flap during suturing in the apical area. The interdental papilla is conserved for esthetics in maxillary central incisor area. After the reflection of flap thorough debridement and curettage is done.[9]

Decortication: By using number 1 or 2 round bur or piezoelectric knife selective decortications are done for alveolar bone activation.

Grooving : In the interradicular spaces, vertical grooves are placed which extends from 2 to 3 mm below the alveolar crest up to 2 mm beyond root apex. Afterwards circular-shaped horizontal corticotomy connected through these vertical corticotomies.[9]

Particulate Bone Grafting : On activated bone particulate bone grafting material is placed, wet by clindamycin phosphate or bacteriostatic water solution 5 mg/mL or platelet-rich plasma, because facilitates the ease of placement. Bone graft such as DFDBA, autogenous bone, deproteinized bovine bone, or a combination are used.[9]

Flap Closure: Flaps are approximated with interrupted loop sutures by using non resorbable material. The epithelial attachment establishment takes place in 2 weeks, after which suture is removed.[29]

Postsurgical management: Antibiotics, analgesics, mouthwash, and ice pack application (postoperative discomfort) advised.[29]

Orthodontic Adjustments : Within 2 weeks, orthodontic treatment should be started, and a heavy orthodontic force must be applied on the teeth following flap repositioning.[29]

Wilckodontics is superior than the conventional orthodontic treatment as it takes lesser time to attain the results. There is less evidence of root resorption and history of relapse. Depending upon the cases many orthodontic appliances such as headgear were reduced**.** It has been declared that after corticotomy with minimal risk of complications, orthodontic treatment progresses faster and the results are more stable.[30]

Wilcko in 2001 suggested bone augmentation with corticotomy to increase the volume of the alveolar process, to prevent fenestrations, to facilitate arch development, and to increase the metabolic activity during orthodontic treatment.[3] A non-extraction treatment of crowding, reducing treatment duration, increasing post orthodontic stability, extrusion of ankylosed teeth, closing anterior open bites, enables retraction of canine in extraction patients, are indications for corticotomy-facilitated orthodontics. Contraindications include patients with chronic periodontitis, poorly treated endodontic problems, patients on long term medications such as bisphosphonates, steroid therapy and NSAIDs.[29] In split mouth study designs, effects of alveolar corticotomies on the rapid tooth movement were reported in rats, dogs, cats and humans. These experiments resulted increase in rate of tooth movement on the corticotomy treated site. Alveolar decortication without subapical osteotomy with rapid orthodontic treatment used for open bite malocclusion.[20] This modified surgical approach was reported in 1991 and was mentioned as corticotomy faciliated orthodontics. In 1991, Suya evaluated 395 adult japanese patients for surgical orthodontic treatment with an enhanced surgical technique and referred as corticotomy facilitated orthodontics. Suya's surgical technique differed from Kole's with the substitution of supra apical corticotomy cut in place of horizontal osteotomy cut beyond the apices of the teeth and varied this technique with traditional orthodontics. Less painful, less root resorption and relapse found in this technique.[31]

A tunnel approach with piezoelectric bone cuts allows placement of the bone graft, as reported by Dibart et al. Through piezo-electric vertical corticotomies, many vertical incisions are performed on the attached gingival and also settles crowding was within 17 weeks of active treatment.[22]

The American Board of orthodontics has described grading system to evaluate the orthodontic treatment quality.[32] In a favour of wilcko's concept, issued data documented that bone grafting increases the orthodontic treatment

stability. Computed Tomographic Scans shows increased volume of bone reported by various cases. However, the fibroosseous material of bone enclosed on the outside of the cortical plate was evaluated. Moreover, disadvantage of this approach are cost morbidity, invasive nature related with the surgery.[8]

CONCLUSION

The procedure of Wilckodontics has transformed adult orthodontics into an actual existence**.** The treatment can be attained within a shorter duration which is applicable to the Regional Acceleratory Phenomenon (RAP). The procedure avoid the conventional orthodontic treatment effect such as resorption of root or dehiscence. In contrast to conventional orthodontic treatment, this technique reveals increased alveolar thickness due to the incorporation of bone grafts, better post orthodontic stability and less incidence of root resorption. As Wilckodontics is a relatively newer approach, so increase in sample size with long term follow up studies need to validate this procedure into surgical orthodontics.

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Case Report

PREVENTION OF NASAL REGURGITATION WITH OBTURATOR IN A NEONATE WITH CLEFT LIP AND PALATE: A CASE REPORT

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Abstract
Food issues, nasal regurgitation, dysfunction of eustachian tube, infections of middle ear, loss of hearing, disorders of speech , orthodontic and other dental conditions are linked to the cleft palate. Obturator is a prosthetic aid that helps provide proper nutrition to feed such infants. It is intended to secure the gap and re-establish the separation of oral and nasal cavity. This article provides a case study on the bilateral cleft lip and palate of a twenty-two-day-old neonate. The obturator was fabricated using acrylic resin for feeding the baby. This feeding prosthesis also obturated the cleft in the palate maintaing the space between the cavities of oral and nasal, which prevented the nasal regurgitation.
Keywords: Cleft lip and palate, feeding appliance, feeding difficulties

INTRODUCTION

The most common congenital defect involving the orofacial region is cleft lip and palate (CLP). The incidence of CLP varies from 0.28–0.374 per thousand live births.1 Cleft palate defect is defined as “a gap within the roof of the mouth caused by failure of the palatal shelves to come back absolutely along from either facet of the mouth and fuse throughout the primary months of development as an embryo”.2

Neonates with a cleft palate face difficulties in feeding, which may contribute to problem in their survival. The oro-nasal contact fails to form negative suckling pressure.3 The baby depresses the nipple between the tongue and the hard palate to accomodate the pressure which forces the liquids and milk out, but if the cleft is large and the nipple is stuck within the defect, this mechanism is insufficient.4 Nasal regurgitation of food and excessive absorption of air leads to constant burping and coughing during the feeding process.3

The management of CLP involves a number of specialists in a team to work. The pediatric dental consultant does the counseling of the mother and provide information to maintain adequate nutrition for the infant. The management of cleft lip and/or palate is required at early stage. The obturator is given as early as possible to the new born. It covers the gap in relation to the cavities of oral and nasal and thus helping the infant in feeding and preventing the nasal regurgitation. A case study of a twenty-two-days-old neonate having cleft of lip and palate bilaterally facing feeding problems and nasal regurgitation is discussed in this paper. The feeding plate was made that also obturated the cleft in the palate to restore the distinction between the oral and nasal cavities to avoid nasal regurgitation.

CASE REPORT

A 22-days-old male neonate visited to the Department of Pedodontics and Preventive dentistry, TMDCRC , Moradabad, with a chief complaint of difficulty in feeding and nasal regurgitation of fluids since birth. The patient was having difficulty in feeding and nasal regurgitation of milk since birth for which he had Ryle’s tube by the pediatrician, who also evaluated cleft in the palate and lip and referred the patient in our hospital for the feeding plate. The mother's pregnancy was normal, and this baby was her first issue. Nothing relevant found in the medical history.

Intraoral examination showed a cleft in the hard and soft palate bilaterally. Cleft was found on both sides of the premaxilla through the alveolus, parting the alveolus free as shown in Fig 1.

According to Veau classification of Palatal cleft the diagnosis was made as Class IV.
Now the fabrication of obturator was initiated.

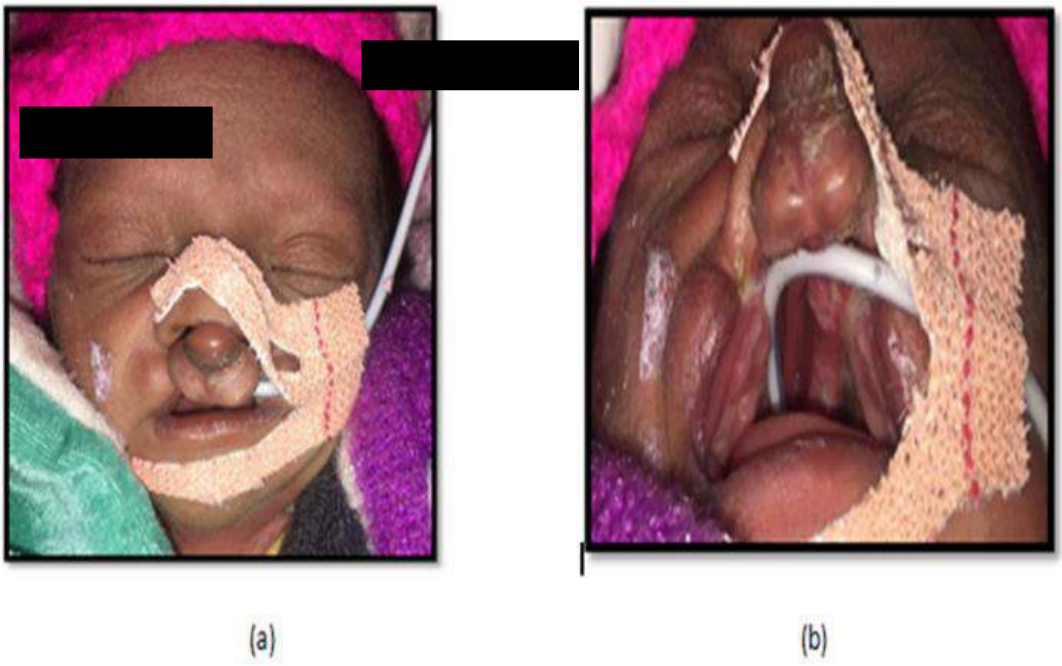

Figure 1: Preoperative (a) extraoral
(b) Intraoral photograph

Procedure for fabrication of obturator:

Primary impression was made using modelling wax by molding with hand and it was adaptated to the palate of the patient. Then the cast was poured with dental stone (type III gypsum). After that special tray was made with autopolymerizing acrylic resin. Secondary impression was then obtained with putty impression material. It was taken care for prevention of aspiration of any excess material. Master cast was poured and block out of excessive undercut was done with modeling wax as shown in fig 2. The obturator was then made using a sprinkle-on technique with cold-cure acrylic. Two eyelets were made using bur to tie dental floss on both sides of the obturator to allow

proper wearing of the prosthesis, and it also allowed safety to avoid swallowing of appliance.

After appropriate cutting, finishing and polishing, the obturator was examined in the oral cavity of the patient, and slight changes were made and the obturator was finally polished. Then it was stabilized by extraoral taping using micropore tape as shown in figure 3. Instructions were given regarding the use and storage of appliance. In the clinics, the appliance was tried in the patients' mouth and the mother of the patient was asked to feed the baby and no nasal regurgitation of milk was noticed. The mother of the infant was told about the method of usage, function, cleaning and maintenance of feeding plate. After 24 hours, follow up of the patient was done and further follow ups were scheduled for new appliance fabrication every 15 days to accommodate normal growth of maxilla.

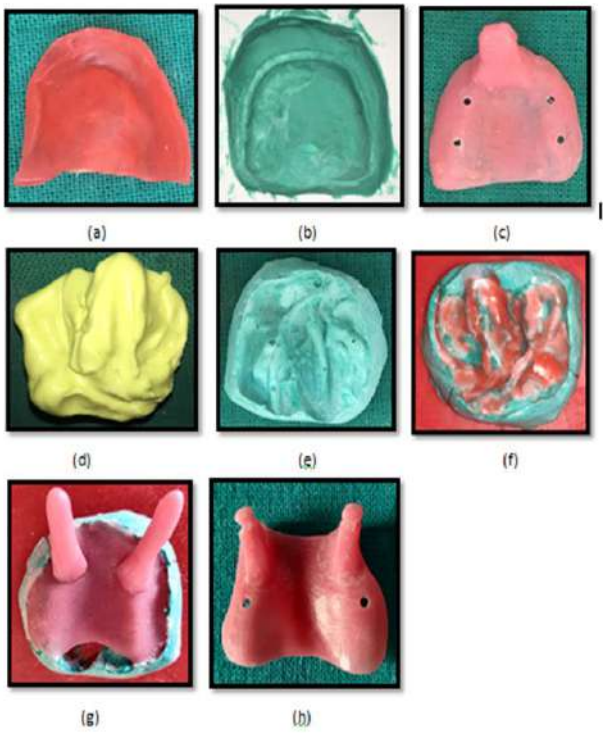

Figure 2: a) Primary impression b) Primary Cast c) Special tray with perforation d) Secondary impression e) Secondary cast f) Blockedout undercuts g) Obturator (h) Obturator after finishing and polishing.

Figure3: Insertion and stabilization of Obturator

DISCUSSION

Multidisciplinarians such as dental specialties (orthodontics, oral surgery, pediatric dentistry, and prosthodontics), medical specialties (genetics, otolaryngology, pediatrics, plastic surgery, from birth throughout puberty, are required for the management of patients with cleft lip and cleft palate. Pediatric dental professionals are responsible for the presurgical and postsurgical treatment phases of maxillary orthopedics. For the proper alignment of the gap , both active and passive appliances are used.

In a survey Young et al. found that 95% of parents had feeding difficulty with cleft lip and palate infant deemed "critical."5 Pandya and Boorman and Wilcox et al. showed in their studies the association of feeding difficulties in infants with cleft palate with failure to thrive and death in developing countries.6,7 Failure to general a negative intraoral pressure and form a lip seal around the nipple due to the oronasal communication and lip defect results in unsuccessful breastfeeding in infants with cleft lip and palate leading to nasal regurgitation.

McNeil first gave the idea of early management of cleft palate patients by presurgical oral prosthesis.8 Mellor & Volp made a valuable contribution to the cleft palate prothesis technique for babies.9 Different approaches have been used earlier to resolve the feeding difficulties in cleft lip and palate infants that include, feeding tubes (orogastric and nasogastric), specially designed feeding equipments (compressible bottles and nipples), and the feeding appliance/palatal obturator.

Feeding appliance serves all the purposes. It is a passive prosthesis system designed to give the cleft alveolus and hard palate a natural contour. Fabrication of this appliance in a newborn has challenges like constraints of size of the oral cavity, variation in size, location, and severity of the cleft, infant's inability to cooperate and follow commands. Selection of accurate impression tray size and the position to be adopted for impression making also is a critical step. A number of positions have been adopted to prevent the accidental aspiration of the impression material including prone, face down, upright, and even upside down.

Jones et al. compared the feeding difficulties before and after the use of obturator in cleft lip and palate infants.10 Decreased choking, nasal discharge, and bottle feed length and improved parental confidence were recorded after 8 months of wearing the obturator. Goldberg et al. illustrated increase in weight with the use of the feeding obturator with the baby having cleft of the hard and soft palate.11

CONCLUSION

The feeding obturator is useful in regular growth of maxilla and it must be inserted at earliest. It helps in nursing, prevents nasal regurgitation, stimulates oral and facial growth, helps to improve the palatal shelves, prevents tongue distortion and irritation of the nasal septum, reduces ear infections, expands the collapsed maxillary section, constricts the enlarged anterior part of the maxilla, which helps health care practitioners' cleft palate team and psychological assistance to parents. A pediatric dentist is extremely important in such cases. They play a dual role in enhancing both the personal effect and the surgical result.

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DAY CARE GENERAL ANESTHESIA IN PEDIATRIC DENTAL PRACTICE- A CASE REPORT

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Abstract:

Dental caries is a single commonest chronic disease of childhood. It is mentioned as an early childhood caries if occurs in a child aged seventy-one months or younger where as in the rampant caries, there is early participation of pulp, and gross destruction of the maxillary anterior teeth same like in posterior teeth. This lead the way to decrease in efficiency of mastication, speech difficulty, esthetics compromised, development of the unusual tongue habits, and abnormal occlusion and psychological problems. The recovery of badly decayed decidous teeth is typically a procedure that presents a unusual challenge to pediatric dentists, particularly in an unhelpful child. The purpose of this case report is to provide a full mouth rehabilitation in an uncooperative child under day care general anesthesia.

Key Words: General anesthesia, Dental caries

INTRODUCTION

Treating young children is often an exacting state for the pediatric dentist. Young one are often uneasy in the dental operatory room and their level of co-operation is restricted. Treatment may be successful only in hands of an expert pediatric dentist. Behavior management approach and sedation offer a lot of chances, even in very young child, and may incorporate child co-operation for required treatment.1 Children with multiple carious lesion presents some additional problem. Thus, general anesthesia may be the treatment modality of choice for serving quality dental care. The purpose of the case report is to deliver total dental rehabilitation for children with multiple carious lesions under day care general anesthesia.

CASE REPORT

A 6-year-old male patient reported with parents to the pediatric dental clinic. The parents complained of decayed teeth and pus discharge in lower left back teeth region since 3 days back. Patient was completely asymptomatic

3 days back when he had pus discharge in lower left back region of jaw. He had pain and difficulty in chewing food. With this he arrived to the Department of Pedodontics and Preventive dentistry, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, U.P.

As observed by the specialist the child was awkward. When he was asking to sit on the dental chair he ignored the instructions. somehow managed to take OPG, and diagnosis was made as multiple carious teeth with irreversible pulpitis in upper anterior and abscess in lower left molar (Figure 1).

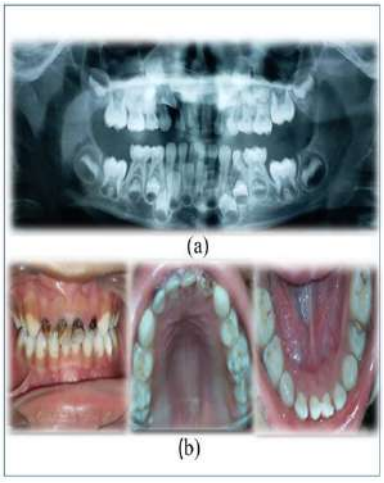

Figure 1. (a) preoperative OPG

(b) preoperative view

Primary behavior-management techniques were tried on the child but had to be given up soon as the child was uncooperative. Keeping in mind the age of the child, complexity of the procedure and the complications that may arise the option of pharmacological means was given to the parents of the child, i.e., sedation and GA. The father was already having idea about GA, told us to proceed with GA. The whole treatment plan was made to understand to the parents.

After due appointment, the patient was admitted to the hospital one day before the treatment planned. Consent was taken in written from the parents. A thorough examination of the mouth revealed multiple decayed teeth altogether four quadrants.

Treatment was planned as extraction i.r.t. 74 followed by band and loop space maintainer. Composite restoration i.r.t. 54, 64 followed by stainless ste el crowns. Pit and fissure sealant i.r.t. 84, 85, 75, 55, 16, 65. Pulpectomy i.r.t. 52, 51, 61, 62 followed by strip crown. Composite Restoration i.r.t. 83, 53, 73 (Figure 2).

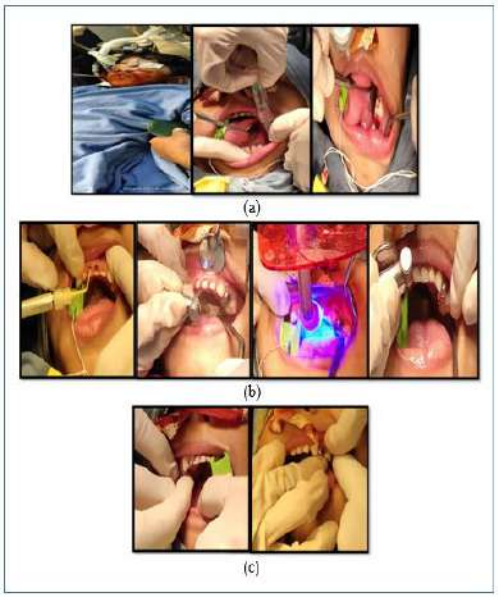

Figure 2. (a) Extraction i.r.t. 74 (b) Pulpectomy followed by Strip Crown i.r.t. 51, 52, 61, 62 (c) Stainless Steel Crown i.r.t. 54, 64

In maintenance phase patient was recalled on next day (Figure 3).

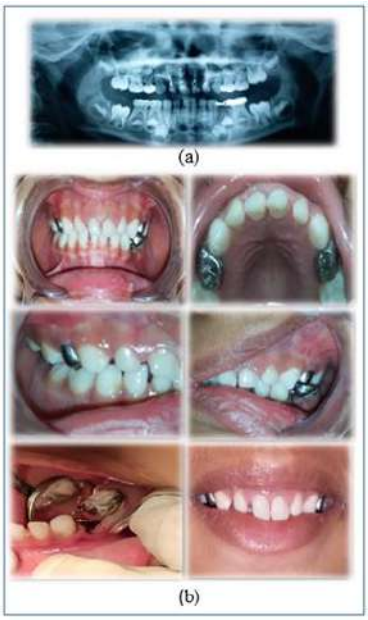

Figure 3. (a) postoperative OPG

(b) postoperative view

DISCUSSION

In spite of the decreasing prevalence of tooth decay in current decagon, a considerable figure of children with early childhood caries (ECC) are still there. Many of these child patients are yongsters and have multiple decayed teeth, which requires prolong and multiple visits. This in turn may cause a problem with behavior modification. Numerous behavioral and therapeutic approaches for the treatment of a child are available.2

In the conventional care setting many young kids with extensive dental association, leads to difficulty in successful treatment, for such cases oral rehabilitation under general anesthesia is recommended to provide quality dental care.2
General anesthesia (GA) was defined as “a drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired. Patients often require assistance in maintaining a patent airway, and positive pressure ventilation could also be required due to depressed spontaneous ventilation or drug-induced depression of neuromuscular function. Cardiovascular function may also be impaired.” 3 – ASA.

Guidelines on use of sedation and general anesthesia for pediatric patient provided by AAPD. The first is for “patients who are unable to cooperate due to a lack of psychological or emotional maturity and/or mental, physical or medical disability.” They also stated that GA is useful in case of children

who are extremely fearful, anxious or unable to communicate, or in instances where it may protect the "developing psyche." Coming towards procedures, they stated that GA is appropriate for surgical procedures4. They also stated that alternative behavior management techniques should be applied before we make use of GA.5

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CONCLUSION

Treatment of children with a highly carious involvement encounter, behavioral problems and with special health care needs in a solitary sitting under GA which will result in an apparently improved dental health. Therefore, a pediatric dentist must have the knowledge of performing dental procedures under general anesthesia for management of uncooperative children and children with special health care needs, thus, rendering better treatment.

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Bilateral Ginglymoarthroidal joint anchyloses: A Case Report

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Abstract

Temporomandibular joint disorders are commonly affecting 28% of population. Congenital Ginglymoarthroidal joint (TMJ) ankylosis is an atypical condition that presents on its own or soon after birth in the absence of acquired factors that could have contributed to the ankylosis such as infection and trauma. Patients usually notice this condition when it results in functional, aesthetics and psychological limitation. This paper highlights the clinical and radiographic features of this atypical TMJ bony ankylosis detected at later stage.

Keyword; Ginglymoarthroidal joint, ankylosis, intraarticular, extraarticular, TMJ.

Introduction:

TMJ ankylosis is a joint disorder, which has been described as the difficulty in opening the mouth. In Greek terminology ankylosis means 'stiff joint'. In this condition fibrous, osseous or fibro-osseous fusion between the mandible condyle and roof of mandibular fossa results in loss of normal rotational and translational movement. [1]

It is associated with various functional disabilities including compromised airway, verbal communication andchewing impairment, poor oral hygiene and caries along with aesthetics deformity due to disturbed growth of face and mandible. According to Neelima Malik ankylosis can be classified into true or false, extra auricular or intrauricular, fibrous or fibro osseous or bony, unilateral or bilateral and partial or complete.[2]

Whereas trauma is the most common etiology of TMJ ankylosis, it can also occur due to infection, rheumatoid arthritis and surgery. In some cases, it can manifest due to congenital and idiopathic factors.

First described by Burket in 1936 congenital TMJ ankylosis has been recognized as a separate condition to the other acquired forms. It is considered as an additional difficulty in the more complex and challenging condition of pediatric TMJ ankylosis. As in children growth period and developing dentition is involved, TMJ ankylosis can have physical as well as psychological effect. Underdeveloped mandible, asymmetry, speech alterations, limited chewing and poor oral hygiene are the various other effects. Early diagnosis and management to prevent alterations due to growth are the prerequisites.[3]

In this article we present one such case with a history representing congenital form and the need for a timely diagnosis.

Case Report

A 16-year-old male patient reported to the Oral medicine and Radiology department of Teerthanker Mahaveer dental college and research centre with a chief complaint of inability to open mouth since birth. According to the patient's father his condition was noticed at early childhood. Medical consultation was not sought until now, as there was no associated pain. The

patient was reportedly on soft diet and the food was inserted through natural front teeth space. He was born full term through normal parturition and has achieved normal growth. No past history of trauma or chronic infection to the ear, face and jaw was reported.

On extraoral examination the state of the patient appears malnourished with no deformity in other parts of the body. Craniofacial assessment revealed a normal head shape, symmetrical eyes and low set ears position. The patient exhibited a "bird-like" facial appearance with retrognathic mandible, facial asymmetry with pogonion deviated to the left side, double chin, and a relatively short neck. The patient was unable to open his mouth and palpation of the pre-auricular region revealed no lateral movement on both sides of the Temporomandibular joint(Fig.1).

Fig.1 Inability to open mouth, "bird-like" facial appearance.

Discussion

TMJ ankylosis although occurs following trauma and infections, it can be rarely congenital. This case was reportedly since early childhood but the ankylosis activity could have started later as there were no retained deciduous. TAT Shaeran et al[3,1] described a similar case where the condition was noted in early childhood, but the absence of retained deciduous molars led them to suspect the ankylotic activity to have started around 7-9 years of age. According to them if the ankylosis was from an early age there should be presence of retained deciduous.

Intraoral examination revealed a permanent dentition stage with class II malocclusion. A mandibular midline shifts and proclined maxillary incisors with increased overjet were noticed. Cusp to Fossa relationship showed zero Maximal Incisal Opening (MIO) making it impossible to examine the tongue and lingual aspects of dentition.

The patient was subjected to panoramic radiography, which revealed a blending of left condyle with glenoid fossa and the condylar head was superimposed by bony mass. The right condyle was condensed tightly to the glenoid fossa, but the outline of the condylar head be left over as a visible separate form. The ramus height of the left side was comparatively smaller than the right side, prominent antigoneal notches were reported on both sides and other findings included horizontally impacted 37 and a root stump of 46. The structures of anterior region of mandible were not clearly visible as the patient's inability to open mouth resulted in a positional error leading to superimposition of cervical spine on anterior region (Fig 2).

Fig .2Panoramic radiograph shows the right and left condyle condensed tightly to the glenoid fossa, and bilateral deep antigoneal notch.

On the basis of clinical and radiographic examination, a final diagnosis of bilateral TMJ ankylosis was given.

A Kamrowska[4] on the other hand described a case, which was exhibiting significant restriction in mouth opening since the age of 6 months, with no history of trauma or infection. She emphasized on the diagnosis of a congenital form if child has restricted mouth opening since birth but if developing with time other factors must be considered.

This is in concurrence with Tideman H[5], who stated that blows to condylar head in infant result in fragmentation of the articular surface, resulting in ankylosis. The failure to diagnose the

childhood injury and the tendency of involuntary mandible immobilization by the child also leads to ankylosis. [1,1]

Clinically the patient's face depicted lower face deformity with a typical bird-face appearance alongwith inability to open mouth and with no palpable joint movement. This is also characteristic of bony ankylosis as with fibrous ankylosis patients will have protrusive movement alongwith pain on forceful opening of mouth.[8]

There are various TMJ imaging modalities including conventional and advanced imaging. Conventional imaging is convenient and readily available but has its own limitations. In our case however because of poor socio-economic condition of the patient orthopantomography was done that revealed a bony mass superimposing the left condyle, thus indicating a bony ankylosis. This is in consideration with the characteristic radiographic feature of bony ankylosis. [8,1]

Various syndromes have been associated with TMJ ankylosis like Treacher Collin and Pierre Robin syndrome. A case of TMJ ankylosis has been reported in association with Carey Fineman Cheong et al[6] and Yew C et al[7] have each described case of isolated developmental abnormality of TMJ and TMJ ankylosis following septic arthritis of the knee, respectively.

Ziter syndrome also. Our case however had not exhibited any associated features of the syndromes. [9,10]

It is necessary to recognize true congenital TMJ ankylosis based on clinical and radiographic descriptions in detail so that any related syndromes can be established.[4,1] A timely intervention and detection plays a key role in management of TMJ ankylosis. [11]

CONCLUSION

Since TMJ ankylosis causes speech, feeding and altered facial esthetics it is a difficult condition to adapt by children and adolescents as it results in psychological disgrace. Hence, detailed and proper history of clinical, functional and radiographic findings are necessary in order to establish a proper diagnosis. Early diagnosis and appropriate treatment is thus essential in restoring normal functioning and balance of the dentofacial complex.

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Review Article

FINGERPRINTS —A KEYTOOL IN FORENSIC SCIENCES

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Abstract

Dactylography is a progressing science and a new method for recording, lifting and developing of prints under different field conditions appearing regularly. Fingerprint identification is the oldest forensic discipline known to man. A fingerprint in its narrow sense is an impression left by the friction ridges of a human finger. Fingerprints have proved over time to be the most rapid, reliable, and cost-effective means by which to identify unknown deceased individuals, especially in a mass disaster setting. The identification of remains through fingerprints accomplishes the most important and difficult mission of the forensic identification operation: the timely and accurate notification of families regarding the fate of their loved one.

Keywords- forensic, fingerprints, crime scene.

Introduction

Fingerprints play a key role in our daily life. We leave our fingerprints at almost every place unknowingly. A fingerprint like any other part holds utmost importance in personal identification. Every fingerprint is unique in itself and two sets of fingerprints can never be alike.

Fingerprints contain rows of pores that are connected to sweat glands and patterns formed by raised papillary ridges on fingertips. [1]

With every passing year and advancement in all fields there is an increase in crime as well. Crime can be of many types like theft, murder etc. For more than hundred years fingerprints have been the gold standard for personal identification within the forensic community as fingerprints remain with an individual throughout life, unless their symmetry is permanently disturbed due to some deep-seated injury. Therefore, fingerprints and finger marks are valuable tool for police and forensic officers in identification of a suspect from a crime scene[1].

BACKGROUND

Fingerprints formation starts with the development of primary and secondary ridges in fingers and palms in the first four months of intrauterine life as described by Bonnevie in 1924, Schaeuble in 1932, Gould in 1948, Hirsch in 1973, Okajima in 1975, Babler in 1991 and Kucken in 2004 whereas according to Cummins primary ridges developed first followed by secondary ridges [6].

FINGERPRINT CLASSIFICATION [6].

A) Loops (about 60--70%):

(a) Radial

(b) Ulnar

B) Whorls (about 25--35%):

(a) Concentric

(b) Spiral

(c) Double spiral

(d) Almond shape

C) Arches (about 6--7%):

(a) Plain

(b) Tented

(c) Exceptional

D) Composite (about 1--2%):

(a) Central pocket loops

(b) Lateral pocket loops

(c) Twinned loops

E) Accidentals

CRIME SCENE

Crime scene can be referred as a certain location where a crime has been committed. Crime scene can be outdoors, indoors and conveyance. Outdoor crime scenes are difficult to investigate due to contamination of the area because of exposure to various elements like heat, wind leading to destruction of evidence. It can also be depicted as any physical environment that could aid an investigator in providing potential evidence. Crime scene investigation is a comprehensive process based on scientific reason and can be articulated as the analysis of interrelationship between people affected by the incident, crime scene and affecting people of the incident [2].

CRIME SCENE COMPONENTS

Crime scene is the first place from where the investigation starts. Crime scene investigation process constitutes of various components, of which crime scene is the main component

TECHNOLOGICAL ADVANCEMENTS FOR COLLECTION AND EVALUATION OF FINGERPRINT

Data collection from the crime scene is an important part of whole investigation. Complex the crime scene, more the number of equipment's and specialised products are required. These technologies used for data collection should have special features and should comply with the standards accepted by forensic sciences.Fingerprints whether full or partial can be well identified with today's technology.

followed by forensic science and human factor. Other key elements include validity, integrity, time and cost.

FINGERPRINTS COLLECTION FROM CRIME SCENE

The ridges in fingerprints consist of information which is structured in three levels named the general pattern, the minutiae and details. These minutiae contribute to the selectivity of the fingerprint making it a tool in personal identification [3].

Fingerprints are generally classified into three main groups naming patent, latent and plastic. A fingerprint formed by transfer of material containing colours like blood, paint and dirt from fingers to the surface is called patent fingerprint and can be easily visualised with naked eyes whereas plastic fingerprint is a three-dimensional pattern on a soft tissue and are collected from surfaces like soap, wax, mud, paste and are made visible with the use of external components like dust, sprays, reflective light sources or chemicals.

Latent fingerprints are patterns that are not easily visible to the naked eye so they are made visible with the use of special filters, lighting techniques or chemical enhancements. Various invisible fingerprints can be made visible by using various physical and chemical methods as fingers leave a mark on the surface touched due to the liquid secreted from the pores on it. All the fingerprints are recorded with technical photographic method after they are made visible to the naked eyes [2]

One such technology is **Automated fingerprint identification system (AFIS).**

It was initially developed to assist the dactyloscopists with computers in the identity verification process of individuals through their fingerprints [3]. They help in identification of individuals based on their fingerprints and are used in law enforcement and security applications. AFIS is a data dependent pattern matching system. Errors have been found in the match making by AFIS because of the use of minutiae-based matching, making it a questionable approach [2].

The CSI constitutes of various other technologies for technical evaluation like IAFIS, ALFIS, MAFIS [2].

Video recording and digital photographing are widely preferred methods due to their ease of use in comparison to previously used film rolls and videotape technologies [2].

Several other prototypes like forenscope, wampire, papilonfosko have been developed for independent collection of fingerprints from the experts working on the crime scene [2].

The FBI's IAFIS service and the US-VISIT's IDENT program are large scale fingerprint systems in the U.S government arena. [4]

NFIQ (NIST Fingerprint image quality) Software is a fingerprint identification system helpful in detecting altered fingerprints if the corresponding image is of poor quality [4].

3D fingerprint images are also used for recognition as they provide higher accuracy with the use of Structured light Illumination (SLI) method [5]

FINGERPRINT DATABASE

Many countries in the world preserve fingerprints of the individuals in the form of database travelling and living in and around the country for identification when needed. INTERPOL has more than 189000 fingerprint records as database. The FBI has around 51 million criminal record subjects and 1.5 million civil fingerprint records in the form of database [6]

CONCLUSION

In the era of advancement with the help of various technologies and enough human resource, fingerprints play a pivotal role in saving the society from criminals, terrorists etc. Hence making our lives comfortable.

The forensic individualization process of fingermarks cannot be considered as a binary decision process but must be envisaged as a purely probabilistic assessment of the value of evidence, as it is for any type of evidence

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Review Article

ORAL HYGIENE IMPORTANCE IN THE TIMES OF COVID-19- A MINI REVIEW

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Abstract

Oral cavity is one of the portals of entry into the human body, and as such it also holds a variety of micro flora, both pathogenic and non-pathogenic, which can traverse the respiratory tracts due to its proximity and in turn leads to infection. It is imperative that the oral health is maintained by performing standard hygiene practices using toothbrushes and antiseptic mouth washes regularly. Therefore, in this Covid-19 era, oral hygiene maintenance should also be given the same importance as hand hygiene to reduce the spread of corona infection.

Key Words: Covid-19, Oral hygiene, Gingivitis, Mouthwash

INTRODUCTION

In the late of 2019, the new coronavirus SARS-CoV-2 was first discovered in Wuhan Hubei Province of China resulting swiftly into a global pandemic bringing about major trouble to the medical community.[1,2] The virus not only affected the human health but also the economy of the world.[2] The WHO on January 30, 2020 declared the outbreak to be a Public Health Emergency of International Concern as its rampant spread continued, creating an increased risk to numerous countries and as a pandemic on March 11, 2020.[3,4]

The severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) has distinctive features i.e. exterior glycoprotein configuration that forms spicules which help the virus binds to human cells and it also has a double layer lipid that act as a protective function to its genetic contribution.[5] The virus invades the human cells through the ACE (Angiotensin Converting Enzyme) 2 receptors. These receptors are distributed in the upper respiratory tract and the epithelial cells lining the salivary glands ducts which are also the early targets of infection. The virus can be found in the mouth especially, on the tongue area.[6,7] The SARS-CoV-2 has been also known to survive on plastic surfaces and stainless steel up to 72 hours.[8]

SARS-CoV-2 infected patients are mostly asymptomatic. Symptomatic cases present mostly with fever, cough, dyspnoea, and myalgia.[9] Some other patients have also given complaints of headache, dizziness, loss of taste or smell including gastrointestinal symptoms such as nausea, vomiting, and diarrhoea.[10] Death occurs as a result of acute respiratory distress syndrome.[11] One of the salient features of SARS-CoV-2 is their capacity to activate an exaggerated immune response in the host, known as 'cytokine storm' resulting in substantial damage to tissues specifically to the lung parenchyma.[12] The pathological features of lung in patients with SARS-CoV-2 pneumonia includes edema, focal reactive hyperplasia of pneumocytes with patchy inflammatory cellular infiltration, and multinucleated giant cells.[13]

A person can get infected by SARS-CoV-2 by immediate inspirations of nasal or respiratory droplets residue in the surroundings and maintaining hand-hygiene is one of the key methods in preventing the indirect transmission of the disease.[14] Hands act as a pool for numerous pathological microorganisms as they are always in touch with various animate and inanimate surfaces including contaminated surfaces. Thus, this global pandemic has brought to light the notable role of keeping hand sterile and clean to fend off extremely infectious diseases.[15]

People have an inbuilt tendency to touch their faces and certain researches have reaffirmed this by reporting on the fact that people end up touching their faces subconsciously for at least 23 times in a given hour; and in this pandemic time, this habit

poses a threat of accidental transmission of the SARS-CoV-2 directly to mouth, nasal cavity or through the eyes.[16]

Oral cavity is regarded as the doorway of entry of numerous microorganisms into the body of a person, hence it became quite relevant to give oral hygiene the same importance as maintenance of hand hygiene. This will eventually play a pivotal role in limiting infection in the oral cavity thereby, eventually cutting its movement into the airways.[17]

Oral cavity the gateway to the human body:

The oral cavity plays a significant role as one of the points of entry of the SARS-CoV-2 along with its convenient location near the airway as well as the salivary glands. The oral cavity also acts as a pool for a great many pathogens of the airway including *Chlamydia pneumoniae*, thus, complications in the form of nosocomial pneumonia may develop in individuals with periodontal disease.[18]

There are various mechanisms that explain the oral microbe's ability to intensify the lung disease. This involves aspiration of oral microorganisms into the lower airway tract; the restructuring of airway tract mucosal surfaces by enzymes from saliva, which helps in the establishment of microorganisms in the tissues; and pro-inflammatory cytokines from periodontitis aid in attachment to lung epithelium and ultimately colonization.[19]

Inadequate oral hygiene is contemplated as a crucial environmental force that directs a network of microorganism groups in the oral cavity leading to imbalance in the ecosystem and this shift promote a growth in the number of oral pathogens. Mastication, flossing, and tooth brushing are daily activities that bring about bacteraemia facilitating spread of oral microorganisms and mediators of inflammation through bloodstream, instigating inflammation. Person with periodontal infection exhibits micro ulcerated sulcular epithelium with destruction of periodontal tissues, increasing vulnerability to bacteraemia.[20]

Thus, maintenance of oral health through rigorous hygiene practice will greatly help in reducing the oropharyngeal colonization, in turn reducing the risk of respiratory complications and is also vital in managing the total microbial load in the mouth, restoring synergetic balance of the oral cavity, and stopping the spread of microorganisms from oral to other parts of the body.[20] Scientific studies have also proposed optimal oral health maintenance thereby decreasing the risk of hospital-acquired pneumonia.[21]

Periodontopathogens and periodontal disease in general were linked with pulmonary afflictions and unfavourable result, especially due to collaborative interactions with viral pathogens.[22] This further emphasizes the importance of maintaining optimal oral health in critical hospitalized patients. Though there is lack of clinical research for now, preservation of oral health is a prospectively practical way to decrease the morbidity and mortality associated with SARS-CoV-2 pandemic.[17]

Studies have reported that SARS-CoV-2 can be retrieved from the saliva and nasopharyngeal swabs thus forming the cornerstone of testing methodology. Oral swabs have been preferred over nasal or oropharyngeal swabs and collection of blood sample as it is less invasive and more agreeable by patients especially when it comes to disease tracking and where mass investigation is vital.[22] But, gingival crevicular fluid (GCF) can also be taken into considerations other than saliva.

GCF is a serum exudate that seeps into the gingival crevices and it has been a popular approach to analyse this fluid for monitoring the state of the periodontal tissue.[23] Poor oral hygiene is a predilection for increased inflammatory exudate which will be reflected in the GCF levels. GCF has been used for detection of other viruses such as herpes simplex, hepatitis C, HIV, etc.[24] And with studies reporting the discovery of SARS-CoV-2 in GCF of COVID-19 patients, we may find use of this fluid for approximating viral load. Sampling of GCF is also a dependable predetermination of the serum immune response and this can be further utilised to infer cytokine levels manifested in monitoring patients of COVID-19. The ACE2 receptor expressed in the oral cavity epithelium plays a vital role in initiating SARS-CoV-2 infection. Thus, we can confer that GCF and ACE2 receptor expression could form a foundation in interpretation of the potential route of infection and the inflammatory status of the periodontium which depends on oral health, which will ultimately impact SARS-CoV-2 infection.[25]

S. Gupta et al. reported the finding of SARS-CoV-2 from asymptomatic carriers and mildly symptomatic cases. This fact brought about a concerning notion as this can lead to infection of unwary health care professionals. The results of this study will not only influence healthcare providers during screening investigations when practices open up, but will also play a major role in policy formulation.[25]

Addy M. in 2020 wrote a letter to the British Dental Journal editor stating his surprise on the fact that oral hygiene practice was not given the same importance as hand hygiene in the fight against SARS-CoV-2. He suggested the use of social media and news platform by concerned authorities to emphasize the importance of oral health and their maintenance. Regular dental care practice will also decrease the infection of COVID-19 among individuals staying in isolation centre and hospital care.[26] Reasoning for the judgement are given in Table1.[17]

Table1: Why maintaining good oral hygiene is important?

1.	Scientific evidence suggests that due to a higher level of angiotensin-converting enzyme-2 expression in the salivary glands, the epithelial lining of salivary ducts, and oral mucosa, these are early target cells for coronavirus, thus SARS-CoV-2 virus colonizes in the oral cavity.
2.	The most common portal for entrance and outlet of viral infectious disease transmission through droplets and aerosol is the oral cavity. Oral cavity harbours numerous pathogens, including viruses, and in dysbiosis condition, the oral ecosystem becomes more conducive for the colonization of potential oral and respiratory pathogens. Viral infection colonizes in the oral and periodontal environment, lower and upper respiratory tract, gingival crevicular fluid, and major or minor salivary glands.
3.	Saliva contains discharges from nasopharynx and lung (due to ciliary actions in airway lining); therefore, the potential of a microorganisms-spill over from the oral cavity to the respiratory system and vice-versa cannot be ruled out.

Bains VK, Bains R. Is oral hygiene as important as hand hygiene during COVID-19 pandemic? Asian J Oral Health Allied Sci 2020;10:5.

Oral hygiene practice in the covid era:

A standard oral hygiene measures include proper cleansing of teeth especially between the teeth with a toothbrush and toothpaste daily. Tongue, the most neglected part of the oral cavity that holds a significant number of microbes should also be cleaned properly. The toothbrushing should done for at least 2 minutes however, prolonging for more than 2 minutes have no additional merits. Ideally, a toothbrush must last for at least three months but sometimes fraying can be seen before 3 months indicating that the person has vigorous brushing habit which should be avoided as it can traumatize the oral mucosa, increasing chances of microbial inoculation and infiltration.[17] Li ZY et al. (2020) have reported the transmission of SARS-CoV-2 through oral mucosal abrasion.[27]

The toothbrush is a tool commonly used to clean teeth and most of the time it is exposed to microbial dental plaque and saliva. Thus, microbes can sometimes hold on to the brushes and remain viable for an exceptional period of time, ranging from a day to a week after toothbrushing and may re-contaminate the mouth and spread it to other individuals when toiletry items are shared or kept together.[28,29]

Tomar P et al. (2014) [30] in his studies reported that after a one-time use, in a time span ranging from 30 seconds to 4 minutes, a toothbrush can become exposed and harbour several microbes as most toothbrushes are kept in the bathrooms. The most neglected practice following toothbrushing is the disinfection of toothbrushes, as most individuals merely clean the toothbrush using tap water and leave them out to dry. Some methods for sanitizing toothbrush include UV rays, submersion into antiseptic mouthwash such as chlorhexidine, use of microwave sterilization and herbal agents. Importance should also be given to cleaning the handle of the toothbrushes with an alcohol-based disinfectant after each use and to prevent cross-contamination, the toothbrushes of family members should not be stored in a common holder.[17] So, in this global pandemic time, it has become especially pivotal to have as separate toothbrush holder, as there are many asymptomatic carriers of the virus and storing brushes together can lead to cross-contamination. Toothpaste shouldn't be shared between family members as this promotes cross-contamination.

Toothpaste contain sodium lauryl sulfates (SLSs), a synthetic organic compound used in many cleaning and hygiene products. It produces froth and causes dissolution and inactivation of numerous nonenveloped and enveloped viruses such as retrovirus, rotavirus, poliovirus, HSV2, and HIV.[31] The SLSs causes denaturation of the envelop and capsid protein of viruses, which renders the virus dormant. Toothpaste have been demonstrated to exhibit a medium range substantivity ranging from 5 to 7 hours.[32]

Daily oral hygiene practice is not complete without antiseptic mouthwashes which is frequently use as oral rinses and gargles. After the H1N1 swine flu outbreak of 2009 in Japan, their government officials recommended daily gargling to prevent airway infections in the populace.[33] Dental societies like the American Dental Association and American Association of Endodontics recommended that pre-procedural mouthwashes should be done with 0.2% Povidone-iodine and 1% hydrogen peroxide prior to any procedures to minimise microbial output in aerosols.[34]

Marui et al. in his meta-analysis study found that there is a mean reduction of 68.4% colony-forming units in dental aerosols when pre-procedural mouth-rinse with 10 ml of chlorhexidine (0.1% or 0.2%), cetylpyridinium chloride, and essential oils is used. Like other respiratory viruses SARS-CoV-2 is also reported to be susceptible to oxidisation.[35]

Slots[36] in his review of economical periodontal procedures, advocated that Povidone-iodine and dilute sodium hypochlorite should be the initial choice for the management of periodontal disease. Sodium hypochlorite (NaOCl), a cytotoxic oxidant is a potent antiseptic and disinfectant against microbes. The approved dose is 8–10 ml of 6% household bleach, diluted in a quarter litre of water, giving 0.25% of NaOCl oral rinse which should be used about 2–3 times a week for 30 seconds. It acts by altering and interfering with cellular metabolism, with resultant inactivation of essential enzymes necessary for the survival of microbes. Accordingly, a habitual use of mouthwashes will reduce pathogens in the oral cavity and upper airway.

To sum it all up, personal hygiene practices are not complete without proper dental care and should not be neglected. Following diligent oral hygiene practice is a prerequisite but it is also necessary to store toothbrushes properly, keeping them clean, thus preventing them from harbouring potential pathogens. So, the first and foremost thing to do during this pandemic is to clean hands preferably with water and soap or sanitize with alcohol-based hand rub (ABHR) before touching the toothbrush. For SARS-CoV-2 patients, it is recommended that the patients have their own complete personal oral hygiene products such as a new soft bristled toothbrush, toothpaste, and a mouthwash which should be stored in a hygienic environment and disposed of properly after patient improves. Methods that

may likely generate aerosols should be avoided such as the electric toothbrushes and water-pik/oral irrigators in this Covid era. For critical and ailing patients with disability and limited manual dexterity, there is a necessity to plan a professional standard oral hygiene programs such as soft triple head toothbrushes, and associated suction toothbrushes).[37]

The Oral health-care providers can also aid the patients in this pandemic time through new approaches such as Tele dentistry which will not expose patients to the risk of cross-infection. With this ongoing pandemic, one of our major priority is to provide satisfactory dental care to emergency cases while ensuring the safety of healthcare providers.[3]

The dental communities should highlight the importance of a proper and adequate oral hygiene to the general public and hospitalized patients. In the Philippines and Indonesia where the "Fit for School"[38] public health program embraces tooth brushing, hand hygiene, and anti-helminthics in school children, efforts should be made to develop and plan similar dental health programs and policies globally in this pandemic era. We should inculcate a habit of brushing thoroughly daily for "Two times for two minutes" and in this pandemic situation, this should be afforded as equally fundamental as following 20 seconds of hand hygiene.[17]

CONCLUSION

The present global pandemic has brought in much misery to the world, disrupting normal lives including the global economy. Many people, as well as the health care providers have lost their lives from Covid-19. Since Covid-19 is spread from nasal or mucosal droplets which means the dentists are at a high risk for covid infection. However, a dental practitioner can still provide care for a patient through teledentistry and for emergency cases by taking proper infection control measures. As for the patients, there are simple measures to follow which will aid a lot in halting the Covid-19 infection. These measures include washing hands properly, practicing social distancing and maintaining oral health and regular sanitization of the surroundings. These steps may seem minor, but they will be vital in getting us back to our normal life.

Conflicts of interest

Nil.

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Review Article

POLYMERIZATION OF COMPOSITE AND ASSOCIATED FACTORS

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Abstract

Composites have become the mainstay of restorations these days. Due to its technique sensitivity, proper handling of material, cavity design, operating field influences the longevity of restoration. Polymerization is one of the major topic of concern regarding the use of composite. Therefore, factors influencing the polymerization and method to overcome should be considered while using composite resin.

INTRODUCTION

In the era of restorative dentistry, gold alloy was preferred as the first choices for restorative procedure. With the time various materials were introduced in the field of dentistry. With a declining acceptance of amalgam among patients, current trend shifted from metallic amalgam to resin-based cements. Composite resins materials have been introduced in the dentistry to minimalize the shortcomings of the acrylic resins which replaced silicate cements. [(1)] Composite material is thermally and electrically inert, without mercury, and, non-metallic with the property of bonding to the hard tooth tissue directly , and confirms a worthy aesthetic appearance of a natural tooth. Bond between tooth-composite is the key factor governing the longevity of these restorations. Composites are pliable to minimally invasive or noninvasive managements associated with consistent clinical performance and favorable properties. Even though composite has many advantages, drawbacks are also associated with these materials. Polymerization shrinkage stress has been widely referring to as one of the most challenging property [(2)] which are primarily influenced by cavity outline and volume, composite resin material properties and placement technique. This article is an attempt to discuss the various factors that influence the polymerization of composite, leading to development of contraction stresses in dental composites and methods to overcome them.

Polymerization mechanism

The dental composite undergoes a chemical reaction between dimethacylate resin monomers. This results in formation of a rigid and cross-linked polymer network surrounding the filler particles. Complete polymerization of the material is determined by the degree of conversion of monomers into polymers which is indicative of the number of methacrylate groups that have reacted with each other during the process of conversion . A polymer chain buildup take place by two distinct polymerization mechanisms either step or chain growth polymerizations. Their mechanisms vary in the types of monomers involved, and on the stages of polymerization at which the development of high molecular weight species is detected. Some monomers will undergo polymerization with any reactive species, while others show high selectivity toward ionic (anionic or cationic) or radical initiator.

In general, chain polymerization occurs in three phases: initiation, propagation, and termination.

1. Initiation: The reactive centers are produced by activation of thermal, photoactive or redox mechanism. Then the reactive centers will react with the monomer molecule , and the breaking of carbon double bonds takes place ,which leads to the macroradical formation .

2. Propagation : The reactive center is uninterruptedly transmitted between the monomer molecules, also each monomer molecule in addition produces a new reactive center. The polymer chain propagates in high speed.

3.Termination: In this process, reactive centers are destroyed (by combination of macroradicals or disproportionation reactions), and the addition of new monomer molecules is limited .

In step-growth polymerizations, (in case of linear polymers) the molecular weight or the polymer network (in the case of cross-linked polymers) does not develop until there is very high degrees of conversion. Here ,the reaction proceeds between two different functional groups, whether they are on the same molecule or different molecules.

Factors affecting polymerization of resin

Factors affecting polymerization	
Incident light	An intensity greater than 400 mW / cm^2 , allowing a reduction of the exposure time is recommended in order to polymerize the composite optimally.
Shade of resin material	Darker composite shades cure slowly and less deeply compared to lighter shades .
Disinfectants and other additives	when chlorhexidine is used as disinfectant there is loss of hybrid layer integrity which compromises resin-dentin bond stability
Temperature	Composites at a higher temperature reduce their viscosity and increase the efficacy of polymerization
Type of filler	The smaller the size of the filler particles, the higher the light scattering occurs.
resin thickness	Optimal thickness (1-2 mm)
Light tip coverings	The reduction in output of light was observed up to 70.5% when latex gloves were used covering the curing tips and 1.6% when a cellophane wrap used.
Light source quality	Wavelength of light soure between 400 to 500 nm. A power density of 600 mW /cm2 is required to confirm that 400 mW/ cm^2 reaches the first increment of composite .
Distance between light curing unit and resin	Minimum distance of < 1 mm, with the light tip positioned 90 ^{0} from the composite surface
Angulation of Light Tip	The tip of the light curing unit should be parallel to the restoration surface to reach maximal light intensity at the surface.

Many factors affect the polymerization of composite such as the shade, duration of light curing, thickness of increment , light curing unit system used, diameter of cavity, location of cavity, distance between light curing tip and the restoring surface, substrate through which the light is cured for example, curing through ceramic, enamel, or dentin), filler type, and temperature. (1)

Polymerization shrinkage stress Despite various developments in restorative materials over the last years, shortcomings related to polymerization shrinkage of composite resin cements remain a clinical problem. Composite materials used in restorative procedures show volumetric shrinkage ranging from 1% to 6%, depending on the curing conditions and formulation. (11) Shrinkage stress of resin-based materials may lead to cusp deflection, enamel crack propagation, marginal and internal gaps formation, and decreased bond strength. (3)

Factors affecting polymerization shrinkage stress:

1. Composite insertion technique- Restoring a city in oblique increments results in a smaller amount of cuspal flexure compared to a single increment based on tests carried out with aluminum blocks. (4) This concept is based on a theory that the ratio of bonded and unbonded restoration surfaces i.e.C-factor determines the shrinkage stress.

2. Modifying the light-activation protocol- Use of techniques to control the light-activation are based on the theory that delaying the composite vitrification allows more release of shrinkage stress by extending the period that composite can flow. For soft-start curing, the light-activation begins with a low irradiance for about 10 seconds followed by increased irradiance for the residual period of light-activation to complete the process of polymerization . (5)

3. Stress absorbing intermediate layer- using a material with low elastic modulus as an intermediate layer under the composite can minimise the shrinkage stress in a concept called 'elastic cavity walls'. (12) Several studies have evaluated the use of glass ionomer , thicker adhesive layers (usually non-solvated adhesives), or flowable composites as a stress absorbing layer. (6)

DISCUSSION

With the invention of composite materials almost 60 years back, these materials have come a long way and have observed lot of changes both in their development and also in acceptance in minds among dentists. In the oral cavity, restorations are subjected to stresses from mastication. These forces act on teeth as well as material producing different reactions that lead to deformation, which can eventually compromise the durability of restoration over time. (7) Adequate physical properties of light cured dental composite resins are achieved when the Light Curing Unit deliver an adequate amount of light at the appropriate wavelength of the respective photoinitiator systems in the composite resins . The polymerization of light cured dental composite resins depends on the power densities and wavelength of light curing unit. Many studies found that the LCUs based on LED seems to be the finest option. (8) Correr et al. found that increasing energy densities for LED and xenon plasma arc increased the MH of two different resins, but that there was no significant difference when the halogen light-curing unit was used with different intensities. [9] Kim et al. (2002) studied the relation between filler ontent and flexural properties and found that the composites with the highest filler content presented the highest flexural strength, flexural modulus and hardness, the maximum fracture toughness was obtained at approximately 55% of filler volume. (10) The type of inorganic particle content and the composition of the resin matrix influence the property of the mechanical resistance of composites.

CONCLUSION

Despite of intense research on bonding mechanisms between the dental tissue and the composites, clinical failure of the bonded interface remains a frequent occurrence. Interfacial defects may develop as a result of long-term mechanical as well as thermal stresses. They may develop while doing the restorative procedure, or due to stresses generated by polymerization shrinkage of composite. Future research will be focused on the development of non-shrinking polymer systems which can be mixed with suitable curing modifiers and fillers to produce restorative materials with excellent qualities. It should be considered that they are highly technique-sensitive, therefore

control over certain factors such as good isolation, correct indication, correct choice of the composite, use of correct procedure for bonding as well as curing gives satisfactory clinical results.

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