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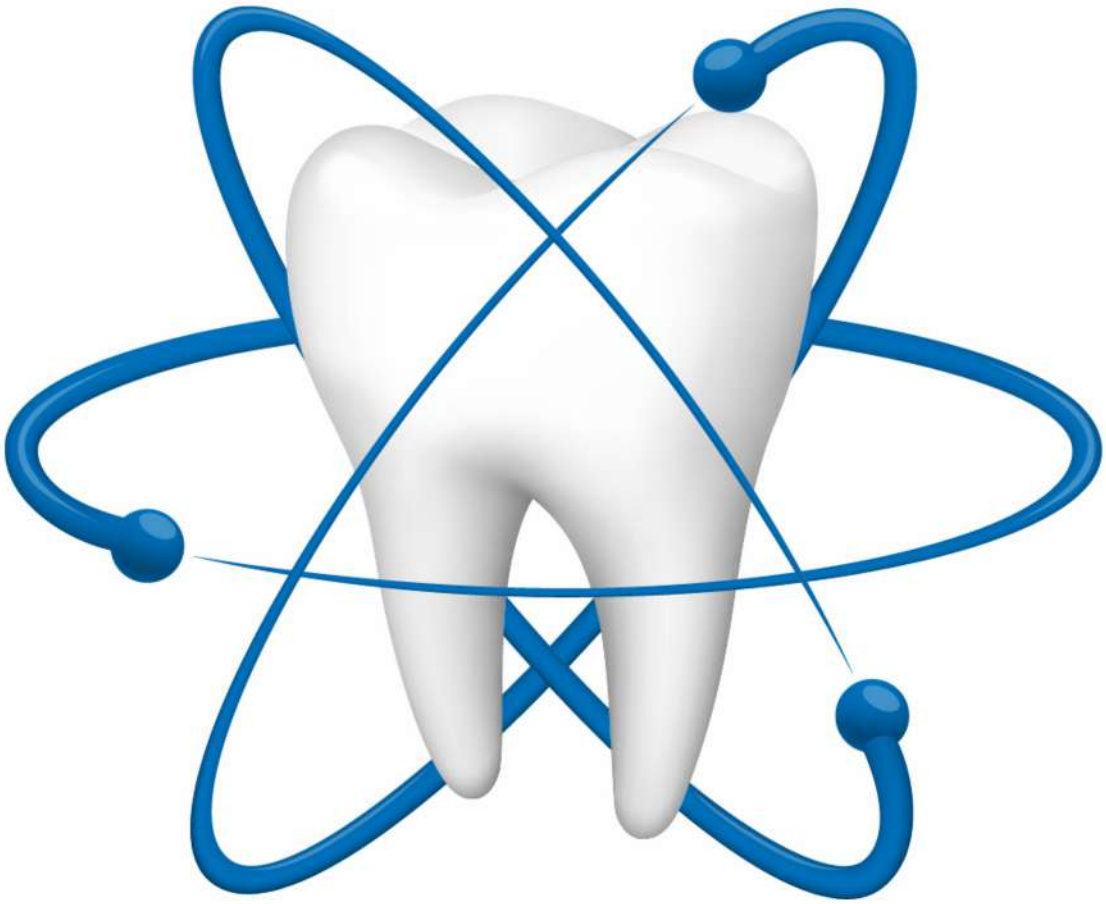

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Editor's Desk

I am very happy to being a part of Desh Bhagat University Dental Journal "International Journal of Dental Sciences & Research" as editor-in-chief. I am fortunate to have team of well renowned, efficient, sincere national and international peer- reviewers, research scholars, editorial board members, and the office bearers to be the part of this journal. I am pleased to introduce the 1st issue for 3rd volume of our journal under the guidance of Chancellor 'Dr Zora Singh', Pro Chancellor 'Dr Tajinder Kaur', Vice Chancellor ' Prof. (Dr.) Abhijit H. Joshi and Dean Academics 'Dr Sunil Malhan.

Our journal is a constructive platform to improve the quality and competitiveness of the manuscript, providing readers with most comprehensive and reliable information in advanced areas of dental sciences. The journal primarily caters to the needs of the dentistry through various multi-disciplinary publications. We publish original research investigations, review articles (systematic and narrative), short communications, editorials, case reports and letters to the editor on basic and clinical issues in dentistry.

I sincerely thank all the authors, reviewers, editorial board members, office bearers of the journal and readers for extending their continuous support and cooperation in bringing out this issue of the year 2023 successfully. Needless to say, any papers that you wish to submit, either individually or collaboratively, are much appreciated and will make a substantial contribution to the early development and success of the journal. I seek support of all interested faculty members, students, institutions and practitioners to give their inputs, comments and valuable suggestions that will improve our Journal's standards and reputation as a reliable source of high-quality information in the field of dentistry.

Dr. Vikram Bali
Edior-In-Chief

International Journal of Dental Sciences & Research

Contents

SHORT-TERM CLINICAL AND RADIOGRAPHIC RESULTS OF PIVOT IMPLANTS: A RETROSPECTIVE STUDY

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Abstract

Purpose: The present retrospective clinical study was undertaken to evaluate the survival rate and marginal bone conditions around Pivot Morse Line implants. The purpose was also to compare the results with when these implants are used forimmediate/early loading where implants were allowed to heal and osseointegrate before loading.

Material and methods: Seventy-Seven consecutive patients who received implant treatment with 119 Pivot Morse line implants at two different centres were evaluated. The implants were placed in both maxilla and mandible for treatment after loss of single and multiple teeth. Immediate/early loading (within 2 weeks) with temporization was done to 85 implants, while 34 implants were allowed to heal for 8 to 24 weeks before loading. Marginal bone loss was calculated using radiographs taken at placement and after an average of 40 weeks (range 1–18 months) of loading.

Results: 13 (10.92%) of the 119 implants failed within 30 days of surgery. All the failed implants belonged to the immediate/early loading group which was 10.52% for the group whereas for the delayed loading failure rate was 0%. All the implants that failed were done using flapless protocol. The marginal bone loss was 2.7mm (SD 1.3) for all implants, while 51 implants (42%) showed more than 3mm of loss during the follow up. Bone loss was recorded to increase with time. Implants subjected to immediate/early loading showed more bone loss than two-stage implants. Moreover, 42% of immediately loaded and 12% of two-stage implants had more than 3mm of bone loss.

Conclusion: This short-term retrospective analysis showed a good clinical outcome of Pivot Morse Line implants. Marginal bone loss (6mm) was within limits and was found in around 33 of the evaluated implants. Less resorption and no failures were experienced when implants were left undisturbed and allowed to Osseointegrate for 8 - 24 weeks before occlusal loading. Within the limitations of the present study, data indicate that immediate loading and flapless surgeries are risk factors for failure of Pivot Morse Line implants.

Keywords: Delayed loading, immediate loading, marginal bone resorption, one-piece implant.

Introduction

Branemark et al in 1977, Albrektsson et al in 1989 and Glauser et al in 2005 through their studies proven that well osseointegrated dental implant can be a viable and predictable treatment option for patient with single or multiple missing teeth. Medical practice regulatory board in India and in western nations don't require new dental implant models to present long term clinical success evidence before entering the market. But it also assumes that the new implant models meet at least the standards set by the older ones. The past data suggests that there have been few dental implant models which have been withdrawn from the market after being very popular. IMZ Cylindrical implant (Dietrich & Wagner 1992; Quirynen et al. 1992; Albrektsson 1993; Haas et al. 1996), Core Vent implants (Malmquist & Sennerby 1990) etc. are few examples of Implants which were withdrawn from the market after showing unacceptable bone loss.

Lately, Dental Implantology has advanced to the biological limits for osseointegration; implant healing time, implants are now being placed immediately after tooth extraction and immediate loading protocols have been introduced (Becker et al. 1994; Glauser et al. 2001; Sullivan et al. 2005). On one hand these approaches have widened indications for osseointegrated implants; on the other they have increased the risk of failure.

In the present study we have tried to investigate retrospectively, a novel two piece morse tapered conical implant system, the Pivot Morse LineTM. It has been marketed as an implant with a magical five degree strong taper connection which provides a strong titanium implant collar which is resistant to fracture.

The aim of this study was to present the outcome of 119 Pivot Morse Line implants, consecutively placed at two different dental institutions

Material and Methods

Study design: Two institutional centres were selected which had substantial experience in dental implantology and they were invited to participate in this retrospective study. Instructions to the participating clinicians included that the implants included in the study should be placed consecutively and no implant selection should be done. A total of 77 patients (40 males and 37 females) who received dental implant therapy at the two centres with Pivot Morse line implants were included in the study

The implants had been used in both jaws (54 maxillary and 65 mandibular implants) for treatment after loss of single (47 constructions) and multiple teeth (30 constructions). Sixty-six implants were placed using a flapless approach while a flap procedure was used for 53 implants. Ninety-nine implants were placed

in healed sites and 20 in extraction sockets.Immediate/early loading (within 2 weeks) with temporization was donein 85 implants, while 34 implants were allowed to heal for 8 to 24 weeks before loading.

Radiographic evaluation: Marginal bone was evaluated using digital radiography after surgery and after 1-18 months with average being 10 months. Periapical radiographs were recorded using radiovisuograph in all the cases. Measurements were made using Carestream Studio Software available with Carestream 6200 sensor at the mesial and distal aspects of implant. Each radiovisuograph was calibrated with the known dimensions of the Implant used. Measurements were made to calculate: 1. True Bone loss i.e. the level of bone initially vs the level of bone during subsequent follow-up visits. 2. Marginal Bone loss i.e. the level of bone in relation to the coronal cylinder of implant.

Success Criteria: Implant success was evaluated using the four-field table defined by Albrektsson & Zarb (1993) with the following categories:

1. **Success:** an implant treatmentwill be judged success if the implant is not mobile, has no associated neuropathy and pain. As many prosthesis were cement retained hence the success criteria was further divided into two groups i.e. Grade 1- an implant which has no mobility and less than 2 mm of bone loss after 1 year of treatment and 0.2mm per year after that. Grade 2- and implant which has no mobility and less than 3mm of bone loss after 1 year of treatment.
2. **Survival:** and implant still in mandible or maxilla but doesn't meet any of the criteria described for being considered a success.
3. **Unaccounted for:** implant were put in this criteria where the patient didn't turn up for the follow-up evaluations.
4. **Failure:** an implant that got removed due to any reason.Statistics: a correlation test was done and the correlation was considered proven if the P< 0.05

Results

13 (10.92%) implants were removed post-surgery in five (6.49%) patients due to evidence of infection. All failed implants belonged to Immediate/early loading category (15.3% failure rate). All the implants that failed belonged to flapless surgery technique which gives a failure rate of 19.70%.

All the failed implants belonged to single tooth restorations (failure rate 27.65%) and zero percent failure for multiple teeth constructions.

Mandibular implant were found to be more prone to failure (9 failed out of 65) compared to maxillary (4 failed out of 54), where the failure rate was 13.85% in Mandible and 7.40% in Maxilla.

Placed Lost Failure			
	(n)	(n)	rate(%)
Allimplants	119	13	10.92
Mandible	65	9	13.85
Maxilla	54	4	7.40
Flap surgery	66	0	0
Flapless surgery	53	13	24.53
Single tooth	47	13	27.66
Multi-unit	72	0	0
Immediate loading	85	13	15.29
Delayed loading	34	0	0
Minorbone grafting	0	0	0
Nografting	119	13	10.92

Table No 1: Number placed and failed implants with regard to jaw, surgical technique, construction and loading protocol

Marginal Bone Loss

Marginal bone loss was measured for 113 cases as rest of them were lost before we could measure and compare the marginal bone loss. The mean follow up period was 40 weeks. We didn't have any patient dropouts. The standard bone loss measured was -2.7mm (SD 1.3). As much as 51 implants (42%) showed more than 3mm of loss during the follow up. Bone loss was recorded to increase with time. Implants subjected to immediate/early loading showed more bone loss than two-stage implants. Moreover, 42% of immediately loaded and 12% of two-stage implants had more than 3mm of bone loss. Study also revealed that the bone resorption increased with time (P<0.00I). The study also revealed the average marginal bone loss to be 2mm (SD 1.3) after 24 weeks, 2.7mm (SD 1.3) after 48 weeks and 3mm (SD 1.4) after 72 weeks. Marginal Bone loss was slightly less in Flapless cases compared to flap cases i.e., 2.0mm SD 1.3 vs 2.4mm SD 1.3. Implants in immediate extraction case showed slightly more bone loss (2.7mm SD 1.3) when compared to the conventional healed bone cases (3.7mm SD 1.4). Implants with conventional delayed loading showed significantly less bone resorption (1.3mm SD 1.3) when compared to the implants loaded immediately or withing a week (2.8mm SD 1.5).

	Allimplants (n¼106)	Immediate loading	Delayed loading
		(n¼472)	(n¼434)
Mean follow up-[weeks(SD)]	40(16.4)	48(18.1)	24(8)
Boneloss[mm(SD)]	-2.93(1.4)	-3.7(1.5)	-1.3(1.3)

Table No 3: Marginal Bone loss from baseline to follow-up

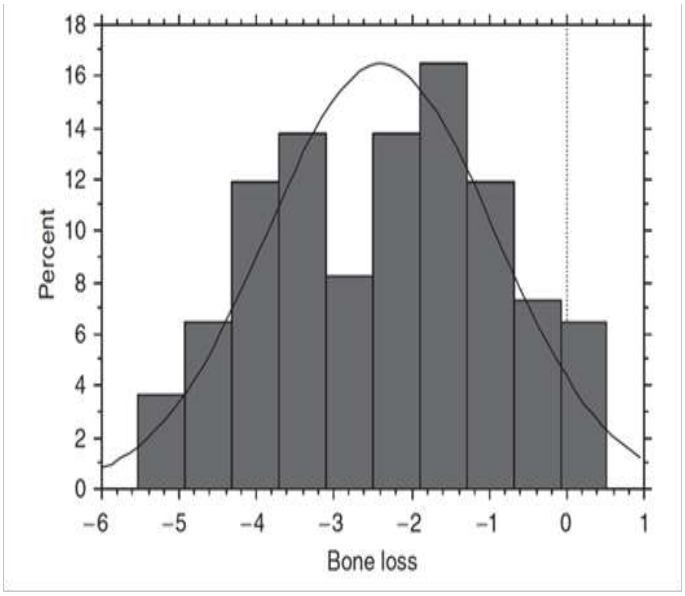

Figure No 1: Frequency- distribution of marginal bone loss

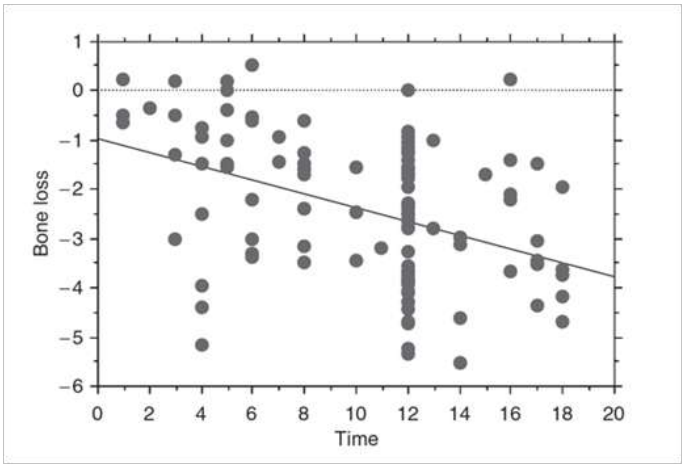

Figure No 2: Correlation plot of time of follow-up against marginal bone loss (Po0.001).

Success Rating

Upon detailed analysis, Success can be considered for 66.9% Implants, Survival for 22.18% and Failure for 10.92%.

Discussion

The result of this study points towards more than normal bone resorption in almost all conditions. Detailed research was conducted on presence of study regarding Pivot Morse Line Implants, but unfortunately till the time of concluding this study no study was available for Pivot Morse Line Implants. The design of Pivot Morse line implants is so unique that we have very sparse data on similar systems. With current limitations of the sparse data, these studies cannot be compared to our study. Pivot Morse line implants don't offer Multi Unit Connection system; hence many multiple implant cases included in our study were given cement retained prosthesis. Cement retained prosthesis leads to extensive peri implant problems due to the retained flush cement. This could be one of the probable reasons for more than normal bone loss. However, there are many other studies available for other implants and implant designs which report good clinical outcomes with immediately loaded cement retained multi-implant cases.

Conclusion

This short-term retrospective study showed almost average bone loss with Pivot Morse Line Implants. The study indicates that the Implant is more suited for conventional flap surgery with delayed loading protocol. Flapless surgery and immediate/early loading are risk factors associated with Pivot Morse line implants. 40 weeks marginal bones loss was slightly on the higher side. With the limitation of the study, further long-term studies with larger sample size are required to reach a conclusion.

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INTERDISCIPLINARY APPROACH FOR MANAGEMENT OF MISSING MAXILLARY INCISOR–A CASE REPORT

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Abstract

Most of orthodontic patients seek orthodontic treatment for improving their smile esthetics. Maxillary anterior teeth are more prone to fracture or loss especially when these teeth are proclined. Loss of these teeth results in functional impairment, impaired esthetics, and psychological impact on patient. Anterior teeth play a prime role in smile and facial esthetics. Treatment of such cases is needed to improve functions and esthetics. Treatment options include space closure, regaining space and prosthetic replacement for lost tooth This paper describes a case report of a patient who has lost one maxillary incisor and also having proclination and spacing in both arches.

Keywords: Smile esthetics, incisor, facial profile, permanent teeth.

Introduction

Facial esthetics is an important concern in today's social life. Dental esthetics has prime importance in overall facial appearance. A pleasing dental appearance plays a key role in framing an esthetic smile and smile is one of the prime human facial expressions and it increases value of face.[1] Most of orthodontic patients seek orthodontic treatment for improving their smile esthetics. Awareness has been increased in people for orthodontic treatment nowadays. Fixed orthodontic treatment can change and enhance esthetics of smile and facial appearance. There are many reasons that make patients to get treatment. These include irregularity in teeth, spacing in teeth, Proclination or retroclination of teeth etc. Spacing can occur in both primary and permanent dentition. In primary dentition spacing is common condition and it has prime importance as it is an indicator for favorable development of permanent teeth. If spaces are not present in primary teeth, it results in crowded permanent teeth.

The incidence of spacing in deciduous dentitions ranges from 98% to 42.9%. Most authors observed an incidence of around 90%. Spacing is more common in the maxilla rather than the mandible and in boys as compared to girls.[2-5]

In primary teeth, spaces develop as they grow up because their jaw is getting bigger and their deciduous teeth remain the same size.[6] Children may also have temporary spaces as their deciduous teeth start shedding out. In deciduous dentition spaces do not cause any harm, rather they are needed for normal development of permanent teeth. Spacing in permanent central incisors is called ad midline diastema. Diastema appears most often in between the two upper central incisors, though spaces can occur between any two teeth and it can happen due to the result of discrepancy between the size of the jaws and size of the teeth. It may also be caused by missing teeth, Microdontia, large labial frenum or habits like thumb sucking.[7]

Case report

Patient came to Department of Orthodontics with chief complaint of forwardly placed front teeth with spacing in upper and lower teeth.

Patient gave history of trauma 7 years back, leading to loss of upper right central incisor and left central incisor became non vital and RCT treated.

Extra oral examination

Extra oral examination revealed convex facial profile, posterior divergence with incompetent lips (fig.1).

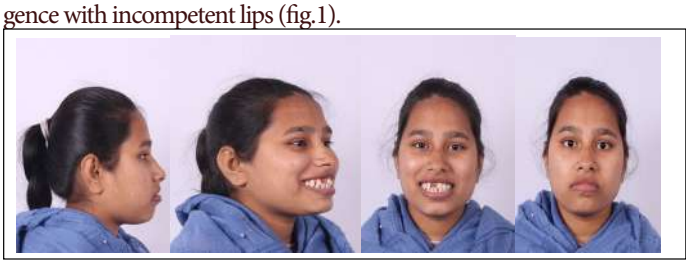


Figure No.1: Pre treatment extra oral photographs of patient

Intra oral examination

On intra oral examination, it was observed that patient has class I molar relation on both right and left sides and class III canine relation on right side and class I on left side with anterior edge to edge bite. All teeth present except maxillary left 3rd molar and mandibular left 3rd molar and maxillary right central incisor. Both maxillary and mandibular arches were U shaped, symmetrical with spacing in anterior region in upper arch and generalized spacing in mandibular arch Fig.2(a-e).

a. Frontal View

b. Mandibular occlusal view

c. Maxillary occlusal view

d. Left lateral view

e. Right lateral view

Figure No.2(a-e): Pre treatment intra oral photographs

Radiographic examination

OPG findings showed dilaceration with respect to mandibular second premolar. Third molars are impacted in left side of upper and lower arch and they were in Nolla stage 9 (fig.3)

Figure No.3: Pretreatment OPG of patient

Cephalometric findings: (Table 1)

1. According to Steiner's analysis, patient has Average Maxilla & Mandible, proclined upper & lower incisors with average growth pattern.
2. According to Tweeds analysis, patient is having average FMA, with proclined incisors.
3. According to Rakosi Jarabacks analysis, patient is having increased saddle angle indication posterior position of condyle and patient having increased Jarabacks ratio that indicates horizontal growth pattern.
4. According to Holdways analysis, patient is having increased H-line angle, increased upper lip strain, protrusive lower lip & decreased soft tissue thickness.
5. According to Burstone analysis, patient is having convex profile, maxillary prognathisim, and prognathic mandible with upper short lip.

Parameters	Value
SNA	83 degrees
SNB	81 degrees
ANB	2 degrees
MAXILLARY LENGTH	82 mm
MANDIBULAR LENGTH	105mm
IMPA	104 degrees
NASOLABIAL ANGLE	103 degrees
U1 TO NA degrees	37 degrees
U1 TO NA MM	10mm
L1 TO NB DEGREES	40 degrees
L1 TO NB MM	13mm
U1 TO L1 ANGLE	102 degrees
SADDLE ANGLE	132 degrees
ARTICULARE ANGLE	143 degrees
GONIAL ANGLE	129 degrees
FMA	28 degrees
Y AXIS	60 degrees

Table No.1: Pre treatment cephalometric measurements

Diagnosis

Female patient aged 17 years old was diagnosed with Angles Class I mo-

lar relationship, class I skeletal pattern. She is having spacing between anteriors in lower and upper arch with convex profile, having bimaxillary protrusion and localized unilateral posterior open bite. Patient is having habitual tongue thrust and proclined upper and lower teeth with average growth pattern.

Problem list

- Proclined upper and lower incisors
- Edge to edge anterior bite
- Spacing in both arches
- Rotations with respect to 14, 44 and 45.
- Missing right maxillary central incisor.

Treatment objectives

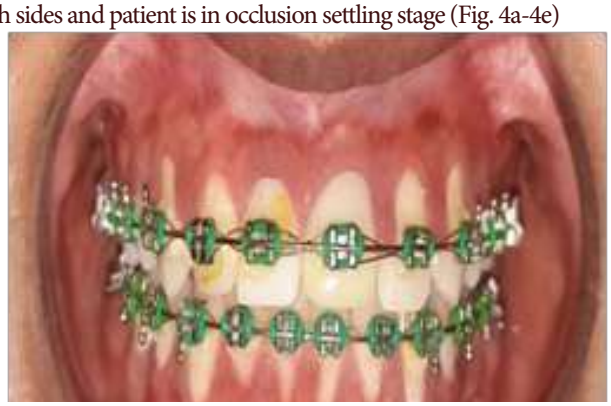
- To maintain class I molar relationship on both sides.
- To achieve class I canine relation on right side and to maintain class I on left side
- To achieve proper overjet and overbite.
- To achieve pleasing smile and facial profile
- To close spaces in both arches.
- To restore missing central incisor.

Treatment plan

- Non Extraction treatment plan was decided by considering all findings and patient's chief complaint
- Fixed Orthodontic treatment with MBT 0.022 slot prescription was planned.
- After initial alignment with NiTi wires, space by use of 0.019" x 0.025" rectangular stainless-steel wires.
- Final finishing and detailing with 0.014" round stainless-steel wires.
- Retention by means of Begg's Wrap-around retainers along with lingual bonded retainers in the upper and lower arch.

Treatment progress

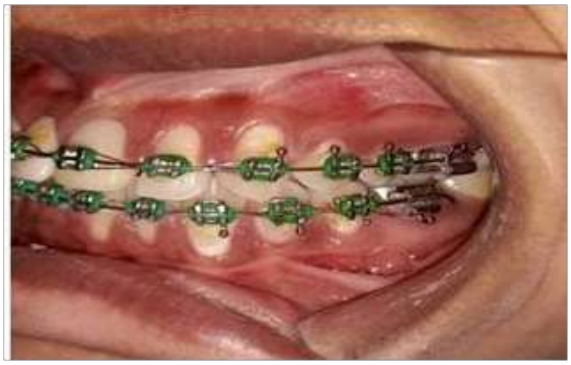
Complete bonding & banding in both maxillary and mandibular arches was done, with MBT-0.022X0.028" slot. Initial 0.012" NiTi wires were used in both arches which were followed by 0.014, 0.016", 0.018", NiTi arch wires. After alignment and leveling with NiTi round. Rectangular NiTi wires followed by rectangular stainless-steel wires. Retraction and closure of existing spaces was started by use of 0.019" x 0.025" rectangular stainless-steel wires. Retraction and closure of existing spaces was done with the help of Elastomeric chains delivering light continuous forces and replaced after every 4 weeks. Space is maintained for prosthetic restoration of lost upper right central incisor. Temporary crown was placed during treatment. Spaces were closed in both arches. At present, spaces has been closed, Class I canine and molar relation on both sides and patient is in occlusion settling stage (Fig. 4a-4e)



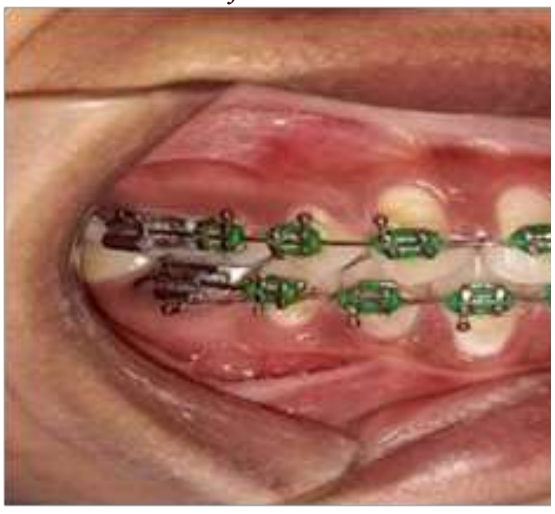
a. Frontal view

b. Maxillary occlusal view

c. Mandibular occlusal view



d. Left lateral view



e. Right lateral view

Figure No. 4(a-e): After closure of all spaces in both arches

Discussion

An attractive smile in modern day society is considered an asset in work settings and social interaction, as it plays an important role in facial expression and appearance.[8]

Missing maxillary incisors have a major impact on facial and smile esthetics, which affects self-esteem and general social interaction of an individual.[9]

This paper presented case report of a patient with lost maxillary incisor along with spacing and proclination of anterior teeth.

Loss of anterior tooth leads to tipping of adjacent teeth, overeruption of antagonist teeth, deviation of midline to one side, masticatory impairment, speech problems, and lingual dysfunction. The conditions which are favorable for space regaining are normal intercuspation of posterior teeth with well aligned anterior teeth, spacing in maxillary dentition, more size difference of canine and premolar. The cases which favour space closure are the crowding in maxilla with balanced profile, similar size of canine and premolar, Class II malocclusion, and mild proclination of anterior teeth.[10] In present case there was spacing present and we planned to close spaces and maintain space for prosthetic replacement for central incisor.

In an ideal female profile, the lips should be slightly everted towards their base, displaying several millimeters of vermilion border, and the upper lip should be positioned slightly anterior to the lower lip. The mentolabial sulcus must form an S-shaped curve in both the upper and lower portions. Furthermore, chin prominence should be slightly smaller than lower lip prominence. In this patient, all these characteristics were adversely affected by increased overjet and lower lip interposition, which was adequately resolved by the treatment performed.

Before starting the case we did kesling setup for the case, and according with the case as non extraction. In this case, a minimal anchorage was used as anchorage for closing of generalized spacing in both the arches. Moreover the patient smile was fair as there was missing central, for that we gave acrylic crown in order to maintain space and for the aesthetic purpose. The patient was skeletally class I and she was having class I molar relation on both sides but incisal relation was edge to edge (class III). In the post-treatment phase the lower incisors were moved backward in segmental technique, canine followed by incisors by short e chain. Thus, the spacing was corrected primarily by slightly figure of eight consolidation and slight retraction of the maxillary incisors with lip compentency. The patient is on settling phase, When carefully planned, however, great results with lasting stability can be achieved.

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DENTAL CARIES: ETIOLOGY, PATHOGENESIS, DIAGNOSIS AND MANAGEMENT

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Abstract

Dental caries is also called as dental decay or cavities in tooth. It occurs from acids produced by bacteria by metabolizing carbohydrates. Initially it appears as white spot lesion which converted into gross cavity if proper intervention is not provided. Dental caries can be diagnosed clinically by visual tactile method of examination. There are various diagnostic aids available for its diagnosis such as radiographic examination using OPG, IOPA, bitewing X-ray, dyes, advanced methods like Fiber-optic transillumination, Wavelength dependent FOTI, Digital imaging FOTI etc. There are various factors contribute for the occurrence of dental caries such as high oral bacterial counts, frequent consumption of sugar-containing foods, inadequate fluoride exposure, low socioeconomic status, xerostomia due to medications or disease and physical disabilities which causes impaired oral hygiene. This paper will discuss about etiology, pathogenesis, diagnosis and management of dental caries.
Keywords: Dental caries, bacteria, microbes, oral cavity, diagnosis.

Introduction

The human body makes residence for trillions of microbes and oral cavity is one of the biggest sources of microbes. Around 700 to 1000 species of microbes colonize the human oral cavity. There is close association between oral microbes and occurrence of oral diseases like dental caries, periodontal and gingival diseases and oral cancers.[1-3]
The term 'Dental Caries' was first time reported in literature around 1634. It came from Latin word 'caries' which means decay. In the starting, it was used to denote holes in teeth. It is observed as one of the oldest and most prevalent disease occurring in humans. It is chronic infectious disease which results from tooth adherent cariogenic bacteria. These bacteria produce acids by metabolizing sugars and these acids results in demineralization of tooth structure.[4]
Caries and periodontal diseases are the main oral health problems in developing countries.[5]Although improved oral health is seen in most of the developed countries, but there are still people with dental problems usually belonging to low socioeconomic status.[6] These oral problems are prevalent in all ages and demographic and socioeconomic groups. Dental caries is most prevalent in Latin America, South Asia, and the Middle East and least common in China.[7] Dental caries occurrence increase with age due to use of denture and poor oral hygiene. Oral diseases such as tooth loss, dental caries, oral mucosal and periodontal diseases, and HIV/AIDS-related oral diseases are the main public health problems in the world. Out of total 291 diseases and injuries evaluated in global burden of disease, untreated tooth decay has the highest rate of prevalence between 70 and 90% of populations, and it is also one of the most common reasons for tooth extraction.[8]
Irrespective of geographic location in the world, both genders are affected from the condition. World health organization observed that 60 to 90% of school children and approximately 100% of adults across the world are affected from dental decay. So the prevention of dental caries plays a prime role in public health management. Federation Dentaire Internationale (FDI) gave the minimal intervention dentistry definition for management of dental caries in year 2002, and emphasized that the existing preventive measure is to maintain a healthy tooth structure as much as possible. Recently it is recommended to detect and monitor caries at early stage, instead of waiting until a cavity is formed. Thus the prevention of dental caries was shifted from the surgical model to a medical model, and the number of individuals getting preventive oral health care has been increasing in recent years. Prevention of dental caries preserves a sound tooth structure, prevents the demineralization of enamel, and promotes natural healing processes.[9]

Etiology of caries

Dental caries is a chronic, multifactorial dental disease which leads to damage and demineralization of hard tooth structure due to acid produced by bacteria.[10]

Theories of dental caries

Early Theories of Caries Etiology
The legend of the worm theory: Ancient Sumerian Text Known as "the legend of the worm" found 5000 BC

Endogenous Theories

Humoral theory - According to this theory, when there is an imbalance between the humors of body, it results in tooth decay.
Vital theory- According to this theory tooth decay originated from within the tooth itself, like a bone gangrene.

Exogenous Theories

Chemical Theory: Parmly proposed that an unidentified "chymical agent" was responsible for caries. According to this theory, teeth are destroyed by the acids formed in the oral cavity by the putrefaction of protein which produced ammonia and was subsequently oxidized

to nitric acid. Robertson also stated that tooth decay is produced by the fermentation of food particles around the teeth.

Parasitic theory: This was the first theory which gives relation ***between micro-*** organisms and caries. It was proposed that even though caries starts purely as a chemical process, but microorganisms continued the disintegration in both enamel and dentin.

Chemicoparasitic theory (1890) (Acidogenic Theory): It explains-microbiological basis of dental caries and proposed in 1890 by W. D. Miller in his book titled "The microorganisms of the human mouth" based upon the work done in Robert Koch's laboratory in Berlin. This theory showed that the degradation of carbohydrate-containing foods resulted in acid formation and was able to demonstrate this process in vitro with isolated oral bacteria and extracted teeth.

Miller summarized his theory as: Dental decay is a chemoparasitic process consisting of two stages that are decalcification or softening of the tissue and dissolution of the softened residue.

Miller advocated an essential role of three factors in the caries process:

- The oral microorganisms
- The carbohydrate substrate
- The acid.

This theory is still considered as the backbone of current knowledge and understanding of the etiology of dental caries.

The proteolytic theory: This theory was given by Gottlieb and Gottlieb 1944.This theory stated that the organic or protein components of tooth are the initial pathways of invasion by microorganisms and, dental caries is essentially a proteolytic process. In this process the microorganisms enter the organic pathways and damage them while advancing through them by forming acids.So certain structures of enamel having high organic material composition, like enamel lamellae and enamel rod sheaths, could serve as a pathway for microorganism invasion through the enamel.

Proteolysis chelation theory: The acidogenic and the proteolytic theory were addressed in this proteolysis chelation theory. This theory was given by Schwartz and his co-workers 1955. Chelation is a process in which there is complexing of the metal ions to form complex substance through coordinate covalent bond which results in formation of poorly dissociated /or weakly ionized compound.[11-14]

Contributing factors for dental caries

1. Host factor

a. Tooth factor

- Morphology and position in the arch
- Chemical nature

b. Saliva

- Composition, pH and antibacterial activity
- Quantity and viscosity of flow

2. Microflora

3. Substrate or diet (physical nature and chemical nature)

4. Time.

Host Factor

a. Tooth Factor - Morphology and position in arch

Deep pits and fissures are more prone to carious attack as compared to smooth surfaces of teeth because of food accumulation and bacterial stagnation occurs more in these areas. The permanent mandibular first molars due to having more complex occlusal morphology with numerous pits and fissures are most prone to dental decay followed by the maxillary first molars and mandibular and maxillary second molars.

The position of the tooth in the dental arch also plays an important role in the incidence of carious lesions. Irregularities in the arch form, crowding and overlapping of the teeth also favor the development of caries as these areas provide an excellent environment for plaque accumulation.

Partially impacted third molars are also more prone to dental caries.

Chemical nature

The chemical elements of enamel such as dicalcium phosphate dihydrate and fluorapatite make the enamel resistant to caries to a certain extent. The presence of mineral ions such as Ca, F, Zn and Fe in more concentrations decreases the enamel solubility, hence decreasing chances of dental decay. Higher the solubility of the enamel surface leads to higher susceptibility to caries development. The mineral content of enamel tends to increase with advancing age, so increased resistance to carious attack.

b. Saliva -Composition

The concentrations of inorganic calcium and phosphorus show alterations within resting and stimulated saliva. Individuals, who are more prone to caries, have low calcium and phosphorus levels. Salivary proteins such as statherin, acidic proline-rich proteins, cystatins, and histatins help in the maintaining the homeostasis of the supersaturated state of saliva. According to Hay and Moreno (1989), statherin is present in stimulated saliva in concentrations sufficient to inhibit the precipitation of calcium and phosphate salts. Studies by Gibbons and Hay (1988) have shown that statherin may contribute to the initial colonization of the tooth surfaces by certain bacteria.

The acidic PRPs bind free calcium, adsorb to hydroxyapatite surfaces, inhibit enamel crystal growth, and regulate hydroxyapatite crystal structure (Hay and Moreno, 1989).

The amount and quality of acidic PRPs and agglutinins are observed to be variable in caries-free and caries-active individuals as shown by the studies of Rosan et al (1982) and Stenudd (1999). The role of cystatins in the caries process is not clear. However, they may play a minor role in the regulation of calcium homeostasis in saliva. Phosphorylated and non-phosphorylated cystatins bind to hydroxyapatite.

Salivary flow rate, pH and buffer capacity

Saliva has the most important function of caries prevention by way of its flushing and neutralizing effects, commonly referred to as 'salivary clearance' or 'oral clearance capacity'. As a thumb rule, the higher the flow rate, the faster the clearance and the higher the buffer capacity. Decreased salivary flow rate leading to reduction of oral defense systems which may cause severe caries and mucosal inflammation.

The pH of saliva at which it ceases to be saturated with calcium and phosphorus is referred to as the 'critical pH'. Normally, the critical pH is 5.5. Below this value, the inorganic content tends to demineralize. The normal pH of resting saliva is 6–7.

Buffering capacity

The buffer capacity of both unstimulated and stimulated saliva consists three main buffer systems: the bicarbonate (HCO−3), the phosphate, and the protein buffer systems. These systems have different pH ranges. The bicarbonate and phosphate systems have pH values of 6.1–6.3 and 6.8–7.0, respectively.

Since most of the salivary buffering capacity operative during food intake and mastication is due to the bicarbonate system, sufficient saliva flow provides the oral cavity with the neutralizing components.The phosphate and protein buffer systems make a minor contribution to the total salivary buffer capacity, relative to the bicarbonate system. The phosphate system is, in principle, analogs to the bicarbonate system but without the important phase-buffering ca-

pacity, and it is relatively independent of the salivary secretion rate.
It is a well-established fact that the buffer capacity of the saliva and the caries experience are inversely related.
The buffer effect of saliva is influenced by the hormonal and metabolic changes, as well as by altered general health. It is generally accepted that the buffer effect is greater in men as compared to women. In women, the buffer effect decreases gradually, independent of flow rate, toward late pregnancy and promptly recovers after delivery. Introduction of either hormone replacement therapy in menopausal women or low-dose oral contraceptives can slightly increase the buffer capacity.

Antibacterial activity

The primary oral innate defense factors are peroxidase systems, lysozyme, lactoferrin, and histatins. In vitro studies have proved that these proteins are known to limit bacterial or fungal growth, interfere with bacterial glucose uptake or glucose metabolism and promote aggregation and, thus eliminate bacteria.
The immunoglobulins, IgG, IgM, IgA, and secretory IgA (sIgA), form the basis of the specific salivary defense against oral microorganisms, including Streptococcus mutans. The most abundantly found immunoglobulin in saliva is dimeric slgA, which is produced by plasma cells present in the salivary glands. Two IgA subclasses are present in saliva; IgAl forms the major component of immunoglobulins, although the relative amount of IgA2 is higher in saliva than in other secretions.Salivary IgA is absent at birth but is generally detectable by the age of 1 week.
In human beings, IgG, mainly of maternal origin, is the only detectable immunoglobulin in the saliva of neonates. Its concentration reduces to non-detectable levels after some months but appears again after tooth eruption.

Quantity and viscosity of flow

The viscosity of the saliva and the amount of saliva produced has a significant impact on the incidence of dental caries.The average person produces at least 500 ml of saliva over a period of 24 hours. The unstimulated flow rate of saliva is 0.3 ml/min, whereas the flow rate during sleep is 0.1 ml/min and during eating or chewing, it increases to 4.0 to 5.0 ml/min. Any reduction in this quantity of saliva as seen in diseases such as Sjögren's syndrome, diabetes, etc. predisposes to dental caries.
Increased viscosity of saliva may prevent its natural cleansing action thereby promoting the deposition of plaque on the tooth surface. Likewise when the salivary viscosity is low, the amount of minerals and bicarbonates are inadequate thereby limiting its anticaries activity.

2. Microflora

The main etiological agent in occlusal and pit and fissure caries is the S. mutans. Deep dentinal caries is commonly associated with lactobacilli, certain gram-positive anaerobes and filaments such as Eubacterium and Actinomyces.Root caries or cemental caries is predominantly associated with Actinomyces viscosus. However other species of Actinomyces such as A. naeslundii and A. nocardia have also been isolated.

3. Substrate and Dietary Factors

The role of diet in the causation of dental caries has been extensively studied.
Various dietary factors have been implicated in the occurrence of dental caries.

Physical nature of diet

It is considered that coarse and fibrous food helps in cleansing the debris from the tooth surface thereby minimizing the incidence of carious lesions. However, refined and sticky starchy food aid in the formation of dental caries.

Chemical nature of diet

It is a well-known fact that food with high refined carbohydrate content has the greatest potential to produce carious lesions.The type of carbohydrate (monosaccharide, disaccharide or polysaccharide), frequency of intake and the time for which the ingested food remains stagnant in the oral cavity or on the tooth surface determine the incidence and severity of the carious lesions.
It is believed that vitamin B deficient individuals have lower incidence of dental caries as this is essential for the growth of oral acidogenic flora and also serves as a component of coenzymes involved in glycolysis.
Vitamin D has an important role in the normal development of teeth. Its deficiency results in hypoplastic teeth which usually have higher incidence of dental caries.
Fluoride content in the diet has no significant role because of its metabolic unavailability. Therefore, the fluoride content in cooking salt and its effect on reducing the incidence of carious lesions is still questionable. However, fluoridated water minimizes the caries incidence.Phosphates, molybdenum and vanadium in the diet helps in minimizing the incidence of carious lesions.

Role of heredity

There are various studies which assessed the genetic modifications in dental enamel, genetic modification of immune response, genetic regulation of salivary function and inherited alterations in sugar metabolism.
It was concluded that heredity plays a subsidiary part in the incidence of caries. It is believed that heredity affects the dental decay only in as much as it controls the shape of a tooth and its pits and fissures and its position in the dental arch.
Senpuku et al (1998) and Acton et al (1999) have correlated specific HLA-DR types with binding S. mutans antigens and S. mutans colonization.
Acton concluded that 'genes within MHC modulate the level of oral cariogenic organisms'.
Mariani et al (1994) in their study of celiac disease, enamel defects and HLA typing observed that HLA-DR3 was associated with increased enamel defects and HLA-DR5, 7 were associated with a reduced frequency of enamel defects. Studies have shown that the genes in the HLA complex are associated with altered enamel development and increased susceptibility to dental caries.

Role of immunity

Salivary IgA and immunoglobulins secreted in the gingival crevicular fluid such as IgG, IgM and IgA along with neutrophil leukocytes and macrophages play an important role in the prevention of dental caries. It is believed that the immune response exerted by the gingival crevicular immune system is more potent compared to the salivary immune mechanism.
Salivary IgA prevents S. mutans from adhering to the tooth surface. The IgG antibodies acting as opsonins, facilitate phagocytosis and the death of S. mutans by the action of macrophages and neutrophil leukocytes.[15]

Pathogenesis of dental caries

Micro organisms that have adhesion ability adhere to salivary pellicle present on tooth surface and they form way for aggregation of other organisms which are unable to adhere to tooth surface initially. For many years, there are two hypothesis considered, one is nonspecific plaque hypothesis—NSPH which considered that all

plaque flora were collectively considered as being pathogenic. Other is specific Plaque hypothesis—SPH means certain specific organisms were pathogenic. Then a new hypothesis was given referred as the 'ecological plaque hypothesis'. According to this pathogenicity to specific species that produce the disease only at specific sites caused by a certain change in the environment of the residential plaque flora. The ecological plaque hypothesis targets the factors that resulted in the environmental change of the plaque.[16-18]

The pathogenesis is discussed under two sections that are:

- Disruption of microbial homeostasis in the 'biofilm'.
- Disruption of mineral homeostasis that is seen between the tooth and the 'oral fluid.[19]

An aggregate of microorganisms in which cells adhere to each other and/or to a tooth surface called as dental biofilm. Fermentable carbohydrates are metabolized by the bacteria present in biofilm and there is production of organic acids, mainly lactic acid. These bacterial products get accumulated in the fluid phase of the biofilm, leading to drop in pH and demineralization of the surface layer of the tooth.[20]

This will lead to increased enamel porosity, the spaces between the crystals become more, and the surface softens, which provides a way for the acids to get deeper into the tooth structure and dematerialize the subsurface.[21]

At this point, the products that are calcium and phosphate, created from demineralization, accumulate in the enamel surface and able to protect it from further mineral loss.[21] The available fluoride can prevent surface demineralization.[22] Sugars are swallowed and cleared by saliva resulting in neutral pH of the biofilm and calcium, phosphate, and fluoride now remineralize the tooth's surface.[21]

If the acidic conditions persist, the pH decrease will continue resulting a condition where the rate of mineral loss in the subsurface is more than the surface, leading to a subsurface lesion. Sufficient amount of mineral loss results in clinically visible white spot. A white spot can be arrested or reversed with behavioral changes and preventive measures implementation. Further progression of caries form micro cavities in the enamel.[21]

Diagnosis of caries

The most commonly dental caires is diagnosed by conventional visual-tactile method. Other methods used are:

- Radiographic examination
- Bitewing
- IOPA
- OPG
- Radiovisiography
- Substraction radiography
- Tuned aperture computerized tomography (TACT)
- Ultrasonic imaging
- Dyes
- Advanced diagnostic aids
- Fiber-optic transillumination (FOTI)
- Wavelength dependent FOTI
- Digital imaging FOTI (DIFOTI)
- Qualitative laser fluorescence (diagonodent)19

Management of dental caries

The prognosis of the dental caries is closely associated to the general condition and oral factors of an individual. There are two methods of caries removal.

First one is nonselective caries removal in which both soft and firm dentine is removed regardless of the approximation of carious lesion to the pulp. This method is also called as complete caries removal or complete caries excavation. The rationale behind this technique is that caries is prevented by this method as it stops spreading of carious lesion as all bacteria and caries are removed. After removal of caries, tooth can be filled effectively with restorative material which is properly retained as available hard sound dentine provides strong basis for it.[23-26]

Second method is selective caries removal in which carious part is selectively removed according to its closeness to the pulp, so soft and/or firm dentine is left and preserved. This method is also called as partial caries removal method. This procedure may be completed in one step or two steps. In one step method, after selective caries removal, cavity is restored with permanent restorative material in a single visit. In two step method, carious dentine is removed in two appointments.[27,28]

White spot lesions can be managed by noninvasive method, which recommends good oral hygiene, the use of fluoride-containing toothpaste, mouthwash, gels, and varnish, casein phosphopeptide amorphous calcium phosphate (CPP-ACP) and casein phosphopeptide-amorphous calcium phosphate fluoride (CPP-AFCP). Management of white spot lesions can also be done by using the resin infiltration technique, which delay or reverse the progression of non cavitated carious lesions.[29,30-32]

Conclusion

Dental caries is a chronic disease that greatly threatens human's health. Dental caries and its related complications can aggravate or induce systemic diseases leading to impaired quality of life. Caries is disease having multifactorial etiology and have high prevalence. It results in destruction of tooth structure if not diagnosed and treated at appropriate time. There is continues research is going on to combat dental caries.

Although there is a relatively well-developed caries management system, the difficulty assessments of dental caries treatment are still needed before making treatment plan. Then caries management plan is conducted to control caries risk factors and manage individual lesions.

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TO INVESTIGATE THE EFFECTS OF AUTOMOBILE TRAFFIC ON THE NATURAL MICROFLORA PRESENT IN THE VICINITY OF DESH BHAGAT UNIVERSITY

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Abstract

Background: To investigate the effects of automobile traffic on the natural microflora present in the vicinity of Desh Bhagat University. This study was done in the Department of microbiology at Desh Bhagat University, Mandi Gobindgarh, Punjab. The influence of vehicular traffic on indigenous microorganisms can exhibit variability contingent upon variables such as traffic density, vehicular discharges, regional ecological circumstances, and the robustness of microbial communities. Furthermore, it is noteworthy that diverse species and strains of microorganisms may exhibit disparate reactions to these effects, and the resultant outcomes may fluctuate across various ecosystems and temporal scales. Our findings suggest that automobile traffic has both direct and indirect impacts on the natural microflora in the vicinity of Desh Bhagat University.

Introduction

The transportation of motor vehicles can elicit both direct and indirect effects on indigenous microbial communities, particularly in regions proximal to roadways or locales with high traffic volume. The present discourse outlines the potential impacts of vehicular mobility on the indigenous microorganisms inhabiting natural environments. Vehicles discharge a range of contaminants, including nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter. The deposition of pollutants onto plants and soil has the potential to impact the microbial communities that are associated with them. Certain microorganisms exhibit sensitivity towards pollutants and may experience a reduction in their population or variety in regions that are heavily contaminated. The regular movement of vehicles over non-paved surfaces has the potential to result in the compaction of soil. The process of compaction results in a reduction of the voids or pore space within the soil, thereby impeding the movement of essential elements such as air, water, and nutrients. The viability and functionality of subterranean microorganisms are contingent upon the availability of oxygen and moisture.[1] The phenomenon of soil compaction has the potential to cause disturbance to the habitats of living organisms and bring about changes in their populations, which may consequently result in alterations in the composition of microbial communities. Frequent vehicular mobility frequently leads to the establishment and preservation of roadside areas characterized by sparse flora. The alteration of natural vegetation and the subsequent introduction of plants along roadsides may result in modifications to the microbial community composition that is linked to the plants. Distinct plant taxa exhibit distinct microbial communities, and modifications in plant cover can influence the quantity and variety of microorganisms inhabiting the adjacent soil and rhizosphere. The presence of roads and parking lots can potentially lead to the discharge of contaminants, including heavy metals, oil, and road salts, into adjacent aquatic systems through runoff. The presence of these pollutants may result in adverse impacts on aquatic microorganisms, causing alterations in their population and composition due to their direct toxic properties. Furthermore, escalated nutrient runoff emanating from roadsides may lead to eutrophication, thereby causing modifications in microbial dynamics and creating a favourable environment for specific species. The operation of automobiles produces notable levels of acoustic emissions, which may have an indirect effect on microorganisms. The presence of excessive noise can lead to disturbances in animal behaviour and migration patterns, thereby having an indirect impact on the interactions between animals and microorganisms. The impact of noise disturbance on bird populations can have consequences for microbial dispersal via bird-mediated mechanisms such as seed dispersal and faecal deposition. It is noteworthy that the extent of these effects is contingent upon variables such as the volume of traffic, types of vehicles, distance from roads, and environmental circumstances specific to the area. Furthermore, the inherent microorganisms present in the environment exhibit a degree of resilience and adaptability, thereby resulting in varying outcomes across diverse ecosystems and temporal scales.[2]

Material and methods

This study was done in the Department of microbiology at Desh Bhagat University, Mandi Gobindgarh, Punjab.

Results and discussion

Impact of Automobile movement on bacteria

The locomotion of motor vehicles can exert various effects on bacterial populations, both in a direct and indirect manner. The present discourse outlines several potential impacts of vehicular mobility on bacterial populations. The operation of motor vehicles has the potential to produce airborne particulate matter and dust. The aforementioned particles have the potential to act as vehicles for bacteria, thereby facilitating their aeroallergenicity and enabling them to disseminate over extended geographical areas. Certain bacterial species have developed adaptations that

allow them to thrive in atmospheric conditions. The likelihood of their dispersal can be amplified by heightened vehicular activity. Vehicles discharge various contaminants, including nitrogen oxides, carbon monoxide, and volatile organic compounds.(2) The presence of pollutants can exert direct toxicity on bacteria or indirectly impact their growth and survival by modifying the surrounding environmental conditions. Elevated concentrations of nitrogen oxides have the potential to facilitate the production of acidic precipitation, thereby exerting an influence on microbial populations inhabiting terrestrial and aquatic environments. Soil disturbance and compaction can occur due to vehicular movement on unpaved surfaces or roadside areas. The aforementioned activities have the potential to cause disturbances in the soil structure, leading to a decrease in the availability of oxygen and changes in moisture levels, which can ultimately impact the bacterial populations. Certain bacterial species exhibit sensitivity towards alterations in soil conditions, and vehicular activity-induced disruptions may result in alterations in the composition of bacterial communities. Roadside environments, including parking lots and fuel stations, have been identified as potential hotspots for bacterial contamination. Vehicles have the potential to release various fluids such as oils and fuels, which can potentially contaminate the soil and water systems with harmful bacteria.[3] The presence of such contaminants has the potential to impact the bacterial communities in the affected regions, leading to alterations in their abundance, diversity, and composition. The movement of automobiles is a significant factor in the discharge of contaminants, such as bacteria, into aquatic environments. The bacteria that exist in road and urban environments have the potential to be carried away by precipitation and subsequently infiltrate streams, rivers, and other bodies of water. The introduction of novel bacterial species or modification of extant bacterial communities can have implications for water quality and ecological processes. The usage of automobiles may have an indirect impact on the dissemination of antibiotic-resistant bacteria. The discharge of wastewater originating from automobile-related activities, such as car washes and service stations, may harbour antibiotics and antibiotic-resistant bacteria. The release of this wastewater into the environment has the potential to facilitate the spread of genes associated with antibiotic resistance and the amplification of bacteria that are resistant to antibiotics in ecological systems. It is noteworthy that the influence of vehicular mobility on bacterial communities can exhibit variability contingent upon several factors, including but not limited to traffic density, vehicular discharges, regional ecological circumstances, and the robustness of bacterial populations. Furthermore, it is worth noting that diverse bacterial species and strains may exhibit distinct responses to these impacts, and the resultant implications may differ across various ecological systems.[1,4]

Impact of Automobile movement on fungi

The locomotion of motor vehicles can exert diverse effects on fungi, either through direct or indirect means. The impact of vehicular mobility on fungi can manifest in various ways. The movement of automobiles has been found to produce dust and particulate matter, which have the potential to act as vehicles for the transportation of fungal spores. The spores have the potential to become airborne and disperse over greater distances as a result of disturbances caused by vehicles. The escalation of vehicular traffic has the potential to augment the dissemination of fungal spores, thereby resulting in alterations in fungal populations across diverse regions.[5] The release of automobile emissions, comprising of nitrogen oxides, carbon monoxide, and volatile organic compounds, has the potential to contribute to the degradation of air quality. Elevated concentrations of atmospheric pollutants may exert detrimental impacts on fungal populations. Certain fungal species exhibit sensitivity towards pollutants, which can lead to a decrease in their growth rate, alterations in their reproductive patterns, or modifications in the composition of their community in regions with high levels of pollution. The vehicular traffic on non-paved surfaces or adjacent areas can have a significant impact on the soil ecosystems. The movement of automobiles can lead to soil compaction and disturbance, thereby impacting the soil's structure and nutrient accessibility. This, in turn, can have an effect on the fungal populations. Certain fungi exhibit specialization towards particular soil conditions and can be vulnerable to disruptions or alterations in soil characteristics resulting from vehicular movement. Fungal contamination may originate from roadside environments. Vehicles have the potential to release various fluids such as oils and fuels, which may result in the introduction of fungal spores or mycelia into the soil and water systems. The presence of such contaminants has the potential to cause modifications in the fungal communities, thereby affecting the diversity and abundance of fungi in the ecosystems located alongside roads. Automobiles have the potential to contribute to the deposition of nutrients in the vicinity of roadways. Nitrogen compounds are present in exhaust emissions and have the potential to serve as a source of nutrients for fungi.[6] The augmented availability of nutrients resulting from vehicular movement can have an impact on fungal growth, potentially providing an advantage to specific fungal species that have adapted to flourish in environments with high nutrient content. The construction of roads and infrastructure intended for vehicular transportation can lead to the fragmentation of natural habitats, thereby impacting fungal communities. Fungi frequently exhibit substrate specificity, wherein they are dependent on particular substrates, such as decomposing wood or plant detritus, to facilitate their growth and reproductive processes. The fragmentation of habitats due to the presence of roads can have an adverse impact on the dispersal of fungi and restrict their access to appropriate habitats. This can result in alterations in the distribution patterns and diversity of fungi.[3]

Impact of Automobile movement on staphylococcus

The movement of automobiles per se does not have a direct effect on Staphylococcus bacteria. Notwithstanding, there exist certain indirect mechanisms through which vehicular mobility may conceivably impact the prevalence and dissemination of Staphylococcus, particularly within the purview of human well-being. The following points merit consideration. The utilization of automobiles can enable the transportation of individuals, including those who may harbour Staphylococcus bacteria. Staphylococcus, encompassing the widely recognized Staphylococcus aureus species, has the ability to inhabit the human body, comprising the skin and nasal cavities. The augmented mobility of individuals via vehicular conveyance has the potential to facilitate the dissemination of Staphylococcus among them.[7]

The phenomenon of crowded spaces and its potential for transmission is a significant concern in certain contexts, such as those involving automobile movement. Examples of such contexts include public transportation and carpooling, where individuals may be in close proximity to one another. Densely populated

areas present avenues for interpersonal dissemination of Staphylococcus microorganisms, particularly via physical touch or exhaled droplets. The close proximity of individuals within automobiles has the potential to facilitate the transmission of Staphylococcus if an infected person comes into contact with surfaces or other individuals.[7]

The act of travelling by automobile can potentially interfere with customary hygiene practises, such as hand hygiene. Maintaining adequate hand hygiene is imperative in mitigating the transmission of bacteria, including Staphylococcus. In circumstances where individuals are engaged in prolonged travel or lack convenient access to hand hygiene amenities, the probability of Staphylococcus transmission may be elevated.

The issue of Healthcare-Associated Infections (HAIs) is noteworthy, despite its lack of direct correlation with vehicular mobility. Methicillin-resistant Staphylococcus aureus (MRSA), a strain of Staphylococcus aureus, is a major cause of concern in healthcare facilities. The mobility of automobiles has the potential to facilitate the transportation of individuals, such as healthcare workers and patients, across various healthcare facilities or sites. This particular movement has the potential to facilitate the dissemination of MRSA and other strains of Staphylococcus that are resistant to antibiotics.[7]

The significance of automobile transportation on Staphylococcus is contingent upon various contextual factors such as hygiene protocols, population density, and healthcare environments. It is imperative to underscore these contextual nuances. Observing appropriate hygiene protocols, such as meticulous hand hygiene and ensuring the cleanliness of surfaces in vehicles, can effectively mitigate the risk of Staphylococcus and other bacterial transmission.

Impact of Automobile movement on streptococcus

The movement of automobiles per se does not have a direct effect on Streptococcus bacteria. Notwithstanding, there exist certain indirect pathways through which vehicular mobility could conceivably impact the prevalence and dissemination of Streptococcus, particularly with regards to human well-being. The following points merit consideration.[8]

The utilization of automobiles can aid in the transportation of individuals, including those who may potentially harbour Streptococcus bacteria. Streptococcus species, exemplified by Streptococcus pyogenes (Group A Streptococcus), have the ability to inhabit various regions of the human body, such as the respiratory tract, skin, and throat. The augmented mobility of individuals via vehicular transportation may potentially facilitate the dissemination of Streptococcus among them.[8]

The phenomenon of crowded spaces and gearbox can arise in specific scenarios, such as when automobiles are in motion, resulting in the close proximity of individuals in settings such as public transportation or carpooling. Densely populated areas present avenues for interpersonal transmission of Streptococcus bacteria, particularly via respiratory droplets. The proximity of individuals within automobiles has the potential to enhance the transmission of Streptococcus in the event that an infected person comes into contact with surfaces or other individuals.[7]

The act of travelling by automobile can potentially interfere with customary hygiene practises, such as proper hand hygiene and respiratory etiquette. Maintaining appropriate hand hygiene and adhering to respiratory etiquette by covering the mouth and nose during coughing or sneezing are crucial measures in mitigating the transmission of bacteria, such as Streptococcus. In circumstances where individuals are engaged in prolonged travel or face challenges in accessing hand hygiene amenities, there is a heightened probability of Streptococcus transmission.[3]

The occurrence of healthcare-associated infections is noteworthy in the context of Streptococcus species, specifically Streptococcus pneumoniae and Streptococcus pyogenes, despite their lack of direct correlation with automobile movement. The mobility of automobiles has the potential to facilitate the transportation of individuals, such as patients and healthcare personnel, across various healthcare settings or geographical locations. The aforementioned movement has the potential to facilitate the dissemination of Streptococcus and elevate the likelihood of healthcare-associated infections.[3]

The influence of vehicular mobility on Streptococcus is contingent upon various factors, such as sanitary measures, populace concentration, and medical facilities, thereby underscoring the significance of contextual considerations. Observing sound hygiene protocols, such as appropriate hand hygiene, respiratory etiquette, and upholding sanitary surfaces in vehicles, can effectively mitigate the risk of Streptococcus and other bacterial transmission.

Impact of Automobile movement on airborne bacteria

The movement of automobiles can potentially affect airborne bacteria through various means. The following are essential factors to contemplate concerning the influence of vehicular mobility on aerial bacteria. The operation of automobiles results in the emission of dust, particulate matter, and aerosols, which have the potential to serve as vehicles for the transportation of airborne bacteria. The adherence of bacteria to said particles facilitates their aero-dispersion, thereby augmenting their range of dissemination beyond that which would be expected under unaltered environmental circumstances. The escalation of vehicular mobility has the potential to augment the dissemination of aerial bacteria across wider regions. The release of diverse pollutants into the atmosphere can occur through automobile emissions, including exhaust fumes.[9] The aforementioned discharges may comprise of nitrogen oxides, carbon monoxide, volatile organic compounds, and particulate matter. The presence of pollutants can foster a suitable environment for the proliferation and survival of specific bacterial strains or impact the sustainability of bacterial populations in the atmosphere. Vehicles have the potential to cause roadside pollution, as evidenced by the occurrence of oil or fuel spills, which may result in the introduction of bacteria into the surrounding ecosystem. The bacteria that exist on road surfaces or in close proximity have the potential to become airborne as a result of vehicular activity-induced disturbance, such as tyre friction or the wind generated by passing vehicles. The process of urbanization that is linked to the movement of automobiles has the potential to bring about changes in the composition of microbial communities, which includes the airborne bacteria. Metropolitan regions commonly exhibit elevated degrees of anthropogenic activity, vehicular movement, and environmental contamination, which may impact the composition and prevalence of aeroplankton.[10] The composition of the airborne bacterial community in urban environments can be influenced by various factors, including but not limited to, proximity to roads, population density, and pollution levels. The movement of automobiles may have an indirect effect on the presence of airborne bacteria in indoor environments, particularly in regions that are

situated near roads or have inadequate air filtration. Particulate matter of small size and outdoor pollutants, such as those emanating from vehicular exhaust, have the potential to penetrate indoor environments. The act of introducing bacteria from the external environment into the indoor atmosphere can have an impact on the microbial composition, which in turn has the potential to affect the quality of indoor air. The presence of bacteria in the air, particularly those linked to vehicular activity, may have significant ramifications for human well-being. Certain strains of bacteria have the potential to induce respiratory infections or allergies. Exposure to specific airborne bacteria may carry health hazards, particularly for individuals with pre-existing respiratory conditions or compromised immune systems. It is noteworthy that the influence of vehicular mobility on aerial bacteria may fluctuate contingent upon variables such as traffic density, automobile discharges, regional ecological circumstances, and meteorological trends. Moreover, the prevalence and variety of aerial bacteria are impacted by a range of additional factors, such as natural origins, flora, and human actions beyond vehicular mobility.[10]

The effect of number and volume of automobile on bacteria

The number and volume of automobiles can have implications for bacterial populations in various ways. Here are some effects to consider regarding the number and volume of automobiles on bacteria.[11]

Air Pollution: The number and volume of automobiles on the road contribute to air pollution, releasing pollutants such as nitrogen oxides, carbon monoxide, volatile organic compounds, and particulate matter. These pollutants can have direct or indirect effects on bacterial populations. Some bacteria may be sensitive to pollutants and may experience reduced growth or altered community composition in areas with high traffic volumes.[7]

Traffic Density and Microbial Dispersion: Higher traffic density typically leads to more vehicular emissions and increased disturbance, such as dust and aerosol generation. This can enhance the dispersion of bacteria into the air. Higher volumes of automobiles can potentially increase the likelihood of bacteria being transported over longer distances through airborne dispersal mechanisms, impacting the distribution and abundance of bacteria in the surrounding environment.[10]

Roadside Bacterial Communities: Areas with high traffic volumes often have increased disturbance, soil compaction, and pollution levels. These factors can influence the composition and abundance of bacterial communities in roadside environments. Some bacteria may be adapted to thrive in the unique conditions found near roads, while others may be negatively affected by the disturbances caused by automobile volume.

Runoff and Water Bodies: Increased automobile volume can contribute to greater runoff of pollutants, including bacteria, into nearby water bodies. Bacteria present on roads, parking lots, or nearby surfaces can be washed away by rainfall, potentially contaminating water sources. Higher volumes of automobiles can result in increased bacterial load in runoff, impacting the water quality and potentially affecting aquatic bacterial communities.

Infrastructure and Bacterial Habitat Fragmentation: As the number of automobiles and road infrastructure expands, it can lead to the fragmentation of natural habitats. Construction and expansion of roads can disrupt bacterial habitats and connectivity between different areas, potentially altering bacterial populations. Fragmentation can limit the movement and dispersal of bacteria, leading to changes in their distribution patterns and community composition.

Human-Mediated Spread: Increased automobile volume also means greater human movement and transportation. Human activities associated with automobile use, such as commuting and travel, can contribute to the spread of bacteria. Individuals can carry bacteria on their bodies, clothes, or belongings, and the higher the number of automobiles and associated human movement, the greater the potential for bacterial transmission between individuals and environments.[11,12]

It is important to consider that the effects of the number and volume of automobiles on bacteria are influenced by various factors, including local environmental conditions, infrastructure design, and human behaviors. Additionally, the specific bacterial species and their resilience to disturbances and pollutants play a significant role in determining the overall impact of automobile volume on bacterial populations.[12]

Conclusion

Our findings suggest that automobile traffic has both direct and indirect impacts on the natural microflora in the vicinity of Desh Bhagat University.

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BANDING VS BONDING – AN OVERVIEW

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Abstract

Orthodontic treatment is branch of dentistry which corrects various types of malocclusions and improves smile esthetics and functional occlusion efficacy. This requires application of force on teeth using archwires, springs, loops, elastic chains etc to move teeth in their proper position. This can be possible by fixing some attachments on to the teeth. These attachments can be fixed either by banding of teeth or bonding. In banding procedure, bands are pinched around teeth, on which attachments are fixed, attachments may be bracket, molar tube, lingual button or lingual sheath. In bonding, attachments are directly fixed on teeth by using resin material. This article will discuss in brief about banding and bonding to conclude which is better.

Keywords: Band material, bonding, malocclusion, teeth, and brackets.

Introduction

The value of a beautiful smile is undeniable as smile of an individual is the first thing that is noticed by others. An attractive pleasing smile in modern day society is considered an asset in work place and social interaction as smile plays a prime role in facial expression and appearance.[1] So most of orthodontic patients seek orthodontic treatment to improve their smile and facial esthetics. To create esthetic smile and optimum function of dentition, alignment of teeth in their appropriate positions is needed. This is possible through moving the teeth by applying optimal force to the teeth[2]. In no growing patients space is needed to create to move teeth for correcting the malocclusion.[3] This optimal force is applied on teeth using archwires, springs, loops, elastic chains and elastics etc. which is transmitted to the teeth using a rigid attachment that is bracket. The procedure of placing brackets precisely on tooth surface is called as bracketing.[4] The bracket can be placed on to the tooth surface either by banding or by bonding. Both banding and bonding has their own advantages and disadvantages. The terminal attachment of fixed appliance is placed most commonly on first molar of both arches. This may be molar band with welded molar tube or directly bonded molar tube. As the average time duration of orthodontic treatment is two years. The bonded bracket should be strong enough to withstand the applied orthodontic forces and mastication forces without dislodgement leading to lower failure rates while at the same time these should be safe enough to avoid damage to the surface of teeth during debonding following the end of the treatment.[5] The desired tensile bond strength of metal brackets to tooth structure required to carry out orthodontic treatment is said to be approximately 6 MPa–8 MPa.[6]

The decreased failure rate of attachments reduces the likelihood of emergency visits of patients, improve patient experience and also prevent lengthy treatment times. It has been suggested that 'Loose attachments leading to reduced interest of patient, reduce profitability and disturb the appointment scheduling. Failure rate of attachments should be less than 5%.[7]

Prior to the introduction of enamel bonding techniques, the use of orthodontic bands on first permanent molar teeth was universal. An orthodontic band is a thin seamless metal cylindrical ring, usually made of stainless steel. Bands help to bind orthodontic attachments to teeth. Nowadays bands are mostly placed on the maxillary or mandibular molars. Bands are also placed on other teeth where the surface or shape of tooth is not suitable for bonding bracket. Some orthodontists prefer placing bands on mandibular premolars also bond failure rates on premolar is high during treatment.[8]

Many orthodontists still favour the use of molar bands due to beliefs regarding reduced failure rates and reliability. With improvements in band designs and innovative mechanical retention features further decrease failure rate. Simultaneously, bonded molar tubes have also become increasingly popular due to lower failure rates resulted from advances in design of attachment and materials science. Some authors claimed that molar tubes are more efficient, convenient, allow easier maintenance of oral hygiene and reduce demineralization of tooth surface.[9]

Banding

Orthodontic bands were originally made of precious metal alloys including gold. Stainless steel was later introduced as an alternative to gold alloys. In selecting the alloy for fabricating band, properties necessary for a band material to function well in the oral environment and its easy adaptation to the varied sizes and shapes of teeth were considered. Teeth have variable anatomy specific to each individual including tapered crown forms and compound curves requiring a very formable adaptable material. Bands were originally custom fit for each patients tooth from a ribbon of band material supplied in rolls. A short strip of the band material was stretched and formed around the tooth (pinched) with the overlapping ends soldered together to form a complete ring that is band. This method was quite slow and labor intensive. This needed experienced hands to fabricate a well fitting band. Stainless steel is the alloy of choice which meets all of

these criteria to varying degrees.[8]
Ideal requirements of band material:

- It should fit contours of teeth as closely as possible, thereby enhancing the placement of attachment in relationship of tooth
- It should not extend subgingivally any more than necessary
- It should resist deformation under stress in mouth
- Bands should be made of an alloy that is resistant to tarnish in mouth.
- Material should have enough springiness that it can be forced over the height of contours of teeth and spring back slightly into undercut area.
- It should be polished on surface as possible to reduce the adhesion of food debris.

Indications for banding:

- Banding is preferably done in posterior teeth as bands are able to resist occlusal forces better than bonded attachments. Also bonding needs moisture free area and in posterior tooth area it is difficult to maintain.
- Teeth that need both labial & lingual attachment such as molar with both headgear & lingual arch tubes.
- Teeth with short clinical crown or round buccal surfaces where bonded bracket are difficult to place correctly.
- In young adolescents and recently erupted teeth with high gingival margins favors banding rather than bonding.
- Teeth where frequent breakage of attachment occurs

Advantages of banding:

- Welding or soldering of the attachment is possible that enhances retention. Facilitates both buccal and lingual attachment of auxiliaries.
- Bands provide a broad surface & facilitate the attachment of multiple auxiliaries that can be positioned with precision in an extraoral environment followed by a single cementation procedure.
- Superior reliability due to better resistance to occlusal interferences.
- Interproximal areas are well protected by the banding.
- Removal of the band along with the attachments is easy.

Disadvantages of banding:

- Time consuming procedure compared to bonding.
- Difficulty in maintaining oral hygiene.
- Risk of dental caries under band if it becomes loose by loss of cement seal.
- Difficulty in banding in case of tooth with aberrant shape.
- Difficulty in doing procedures like proximal stripping.
- Placement of band will open small spaces in arch.
- Banded tooth is more prone to caries & decalcification[10]

Steps in banding

Banding of a tooth includes following steps:

1. Separation of teeth
2. Selection of band material
3. Pinching of band
4. Fixing the attachments
5. Cementation of band

Separation of teeth

Due to tight inter dental tooth contacts, it may be impossible to force the band past the contact area. Also it is very uncomfortable to both patient and clinician. So tight contact areas need to be broken before pinching the band. Various types of separators are used for this purpose. To create sufficient separation between teeth, separators need to place for 24 hours or more between the teeth to be separated.

Selection of band material

Band material of suitable width and thickness is selected according to tooth to be banded as variable band materials with different thickness and width are available.

Pinching of band

Proper length of band material is taken and its ends are welded. Then it is passed through the contacts of teeth around the tooth. After this band is tightly pinched around the tooth with band pinching plier to form a ring. Extra band material is cut off and ends are band and adapted close to band. The bent parts spot welded. The gingival margins are trimmed to conform to the contour of gingival margin of teeth. Rough margins are made smooth and polished to prevent any injury to oral tissues.

Fixing the attachments

After completion of band pinching, appropriate attachment is fixed onto the band. Variable attachments are fixed such as brackets for anterior teeth and molar tubes and lingual sheath for posterior teeth. Attachments are fixed welding soldering.[10]
Cementation of band
It is final step in banding. Cementation of band needs adequate moisture control.
Ideal requirements for cements used for fixing bands:

1. Strong enough so that it can keep the band on the tooth for the length of the treatment.
2. It should not be too strong that the tooth surface is damaged when the band is removed.
3. Easy to use clinically.
4. Should have property to protect teeth against dental caries.
5. Cost should be reasonable.[10,11]

Zinc phosphate, zinc silicophosphate and zinc polycarboxylate cements were used as principal band cements until the early 1990s. Glass ionomer or glass ionomer based cements used commonly for band cementation now[12,13]

Bonding

With the invent of orthodontics, orthodontists used to band teeth to correct malocclusion. But Banding was cumbersome procedure, so people were in continuous search for a procedure which can overcome all the possible difficulties of banding. Finally with the advent of acid etching new concept developed in orthodontics, which led to tremendous changes in orthodontics. Bonding is a method of fixing attachments directly over the enamel surface of the tooth using adhesive resins. It was in1977 that the first detailed post treatment evaluation of direct bonding; over a full period of orthodontic treatment in a large sample of patients was published. Today, most Orthodontists directly or indirectly bond attachments to the tooth. In late 1960s, Buonocore had suggested that it was the formation of resin tags that caused the adhesion of the resin to the acid-etched enamel surface of tooth. The resin penetrates the micro- porosities of etched enamel and results in micro-mechanical bond. As time went on, variations in duration

of the acid- etching procedure and concentration of the phosphoric acid, along with alternative acids were tested for the etching of enamel. Bonding had certain advantages over banding.

- Bonded attachments are esthetically superior.
- Bonding if faster & simple procedure than banding.
- Bonding of teeth is less discomfort for the patient.
- Arch length is not increased as occurs with banding.
- Bonds are more hygienic and increased gingival and periodontal health with bonded attachments.
- Partially erupted/fractured teeth can be bonded.
- Proximal enamel reduction is possible with bonded attachments.
- Interproximal areas are accessible for composite build-ups.
- Risk of caries under loose bands is eliminated.
- No band spaces are present to close at the end of treatment.

Types of bonding

Direct bonding: Direct bonding is the technique in which attachment is placed directly to tooth surface with the use of adhesive. For efficient bonding operator must be able to judge the proper position for the attachments and must carry it to place rapidly and accurately.

Indirect bonding: Indirect bonding is done by placing the brackets on a model in the laboratory, then using a template or tray to transfer the laboratory positioning to the teeth .The advantage is the more precise positioning of brackets that is possible in the laboratory.

Advantages of indirect bonding

According to Thomas RG[14]

- Indirect Bonding permits more accurate placement of brackets, during the laboratory phase, vision is optimal and timing is not critical. Brackets can be precisely positioned on the patient's model and changed if necessary.
- Indirect Bonding reduces chair side time of appliance placement from 2 to 3 hours to 25 to 45 minutes. Therefore increased office efficiency.
- Less patient discomfort, since separation is no longer necessary. Moreover long bonding and banding appointments are shortened.
- Interproximal caries can be detected more readily and restored if necessary with no bands in the way.
- Reduces risk of caries and decalcification as is possible under bands, especially loose bands.
- Improved tissue health during treatment.
- Partly erupted teeth can quickly be brought under control. No need to wait for full eruption to cement band.
- No band space to close upon completion.
- No need of costly band inventory.
- Overall better patient acceptance related to esthetics and ease of placement

Fried KH, Newman GV[15] found that indirectly bonded brackets seem to have greater bond strength because the brackets are positioned with pressure during the 3-5-minute setting period with the matrix tray. Pressure enhances adhesion by preventing formation of air bubbles, reducing shrinkage, and promoting a thin glue line. In addition, moisture is excluded from the matrix tray and polymerization takes place in a dry environment

HickhamJ[16] suggested brackets adhere better to the teeth because of less breath condensation and subsequent moisture contamination of the etched and sealed teeth. The rigid indirect tray also holds the brackets in stable positions while the composite cures.

KalangeJT[17] published an article regarding the advantages of indirect bonding. He divided advantages of indirect bonding as:

- Clinical advantage – which deals with the issues related directly to the delivery of orthodontic treatment; i.e. how indirect bonding helps in the 'hands-on' treatment mechanics.
- Technical advantage – relates to those aspects that maximize the accuracy built into the appliances.
- Time in motion combined with ergonomics and efficiency – involves the successful achievement of goals, and their effect on physicians physical condition.

Other advantages of Indirect bonding are:

- Improved ability to bond posterior teeth
- Proposed as a mandatory mode of placement in lingual orthodontics
- Easier ability to rebond brackets – matrices can be stored and can be used to rebond the bracket at the same place.
- Easier ability to build in overcorrections.
- Better in / out and better vertical control.
- Overall healthier ergonomics.
- Visualization of each tooth is not a problem— the patient's cast is held in the hand. The placement of each bracket can be measured precisely with whatever gauge the clinician chooses. In indirect bonding, there is no pressure on the clinician to make quick decisions because the "field" is always dry, easily accessible, and the adhesive has virtually unlimited working time.
- It allows individualizing and optimizing our treatment outcome.
- Less physical and mental stress.
- Enhanced temporomandibular joint health[17] – proper marginal ridge alignment and contact positions achieved during the leveling and alignment phases create a better functional environment and a more stable platform in which to make major anteroposterior changes. This prevents premature contacts and unnecessary interferences of teeth as Class II or Class III malocclusions change to Class I
- Increased post treatment stability[17] – indirect bonding significantly decreases the amount of tooth detailing, resulting in a longer period of gingival fibers to reorganize and provide post-treatment stability.

Disadvantages of indirect bonding:

- This method needs an additional laboratory procedure.
- Additional sets of impression needed.
- Extra laboratory procedure increases cost of this technique.
- More precision is needed while working both in laboratory and in clinical area.
- This technique needs time to correctly and efficiently apply it.
- Improper adaptation of transfer tray in the mouth, leads to insufficient precision in bracket position on teeth.
- Increased amount of applied resin results in excessive resin around the brackets which inversely affect oral hygiene of patient.
- Bonding of brackets to teeth with short clinical crown length is difficult.
- Technique sensitive - Correct technique must be followed closely. Those fearful of change will likely be reluctant to try the technique.[14,18-20]

According to HickhamJ[20] suggested that any technique that does not bond upper and lower arches simultaneously diminishes the advantages of moisture control, stability, and speed. Dependence on commercial laboratories negates the experience, knowledge, and judgment of the orthodontist. It only takes a minute for the doctor to check the bracket positions on the models. Like any bonding technique, indirect bonding depends on maintenance of a dry field to be effective. This is impossible without efficient saliva evacuation. Clinicians must follow an unvarying routine to achieve predictable results.

According to Husain A[21]suggested that occlusogingival insertion of a transfer tray causes the adhesive-coated bracket to scrape along the long axis of each tooth, resulting in more uneven distribution of the adhesive as compared with the perpendicular placement of direct bonding.

According to Zachrisson & Brobakken[19] suggested That bracket bases were not fitted closer to the tooth surface which decreased bond strength. It was difficult to work clean and to remove excess adhesive flash around the bracket bases leads to gingival inflammation and decalcification. The bonding adhesive does not fill out the entire contact surface. Thus artificial undercuts and deficiency areas which are prone to promote decalcification are not avoided.

Sheridan J stated it in an interview[22] "That advantage is more precision in bracket placement. The disadvantage is the possibility of a disaster if the transfer trays are not seated fully."

It would be tempting to postulate banding would be more uncomfortable for patients as the attachment physically surrounds the whole tooth and placement can involve trauma to the gingiva. However, no difference was demonstrated between bands and bonds, low levels of discomfort were reported and patient tolerated both the attachments well. First molars bonds have a higher failure rate than first molar bands. Bonded first permanent molars demonstrated higher levels of post-treatment demineralization than banded first molars. No difference in discomfort was experienced by patients when banding or bonding first permanent molars as part of fixed appliance treatment.

Conclusion

Clinically there is no difference in orthodontic therapy with banded teeth or bonded attachments. These two methods differ from each other in attachment options, separation of teeth, tooth protection, ease in application and sufficiency. Bonding in orthodontics has almost completely taken over banding except in some special situations. Bonding of brackets has changed the practice of orthodontics and has become routine clinical procedure in a remarkably short time. The simplicity of bonding can be misleading. The technique can undoubtedly be mis used, not only by an inexperienced clinician but also by more experienced orthodontist who do not perform procedures with care. Success in bonding requires understanding of and adherence to accepted orthodontic and preventive dentistry principles.

The future of bonding is promising. Modification of technical devices, sealants, adhesives, attachments and procedures are continuing at rapid rate. Careful study of the available information by the orthodontist will be mandatory in keeping up with progress and to use the available materials and techniques for the best results.

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ARCH RECONSTRUCTION TECHNIQUES AROUND ATROPHIC RIDGE AND IMPLANT-A CASE REPORT

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Abstract

Bone volume deficiency is commonly seen that can hamper the placement of prosthesis in that area. So, it becomes great necessity to reconstruct the ridge. This can be corrected by various arch reconstruction procedures. Successful reconstruction depends on multiple biological factors as well as patient compliance. In this case report, ridge reconstruction has been done with particulate bone graft, PRF and collagen membrane. This was followed by the surgical placement of implants.
Keywords:atrophy, bone grafting, dental implants, collagen membrane, PRF, GBR.

Introduction

There are various conditions that result in bone loss like tooth loss, sinus pneumatization, periodontal disease, facial and dento-alveolar trauma, odontogenic and non-odontogenic cysts and tumors, oral pathologic lesions, and many other conditions. that result in bone loss. Alveolar bone grafting can be divided into ridge preservation and ridge augmentation. Ridge can be preserved by bone grafting in extraction socket. Atrophic ridge is the most common problem faced by periodontist1. Atrophic ridge may hamper the aesthetic outcome and compromise functional and structural aspects of treatment. So, it became important to develop techniques that could help to regenerate bone.

Regeneration refers to thereconstitution of a lost or injured part by complete restoration of its architecture and function. Augmentation of bonevolume has been assisted throughdifferent methods, including use of growth and differentiation factors, particulate and blocks grafting materials, distraction osteogenesis, and guided bone regeneration (GBR).

Bone augmentation techniques may be used for the applications of –

1. **Extraction socket preservation (ESP)**- It is seen that in 1 year of extraction, 50% of the alveolar ridge width is reduced. The average amount of loss is seen between 5-7 mm, and 2/3 of this reduction occurred within the first 3 months. Extraction socket preservation is done immediately after the extraction with bone grafting[2]. Different bone materials that can be used for extraction socket preservation.Artzi et al reported 82.3% extraction socket filling with new bone at 9 months after ESP using porous bovine bone mineral (PBBM). Luczyszyn et al introduced a technique using an acellular dermal matrix to cover the socket graft with resorbable HA (hydroxyapatite). The HA affected the ESP outcome, and the matrix contributed to thickening of the soft tissue around the socket. FaciolaPessôa de Oliveira et al. reported successful ESP outcomes after covering with a polytetrafluoroethelne (dPTFE) membrane after minimally traumatic extraction.
2. **Furcation involvement**- these cases can be healed with the use of different bone grafts or in conjuction with GTR membrane. The management of class II furcation involvement presents a unique clinical problem due to the complexity in anatomy at the furcation area. However, the results observed in the present case showed that combined treatment modalities using alloplastic bone graft and GTR membrane are beneficial for the treatment of mandibular grade II furcation defects.
3. **Horizontal bone grafting**- can be done with the use of particulate bone grafts, bone plates, ridge split technique, or with the help of osteogenesis distraction[3].
4. **Vertical bone augmentation**- can be done by particulate bone grafting, bone blocks, bone grafts with GTR membrane,osteogenesis distraction[4].
5. **Immediate implants**-The quality of the regenerated bone around immediate or early implants might be critical in determining the long-term function and stability of dental implants and the peri-implant tissues. To achieve a good osseointegrated implant with a high degree of predictability, the immediate implant might be placed with bone graft and without immediate loading. For aesthetic needs, can be used provisional restoration and free from occlusion. The immediate dental implant placement with autogenous bone graft was significantly superior to synthetic bone graft. In addition, the immediate placement– delayed loaded dental implant remains the procedure of choice for predictably achieving osseointegration[5]. The combination of autogenous bone and synthetic grafts showed a slight superiority to autogenous bone graft alone, suggesting that it could be an optimum bone substitute for treatment of dehiscence around immediate dental implant[6].

Case report

34 years old patient came to the Department of Periodontology and Oral Implantology, Bhojia Dental College and Hospital, Baddi with a chief complaint of mobile teeth in the upper and lower region of the mouth and bad breath from the past 2 years. He doesnot have any medical history. He had an history of chewing tobacco and smoking from the past 5 years and had quitted it year back. On examination, generalised mobility (grade III) and heavy deposition

of calculus was evaluated. There was generalised probing depth >6mm. On radiographic examination (OPG), generalised vertical bone defects were seen.

A definitive treatment plan was made to extract all the teeth and replace them with implant supported prosthesis. Treatment started with the SRP of full mouth and oral hygiene instructions were given to the patient. Patient was recalled for follow up on 7th ,14th day and after 21 days for the surgical procedure.

Surgical procedure

Proper aseptic conditions and proper sterilisation protocol was followed.Patient was advised to do oral rinse with chlorhexidine mouthwash 0.2%.Surgical site i.e. 4th quadrant was anesthetized with 2% lignocaine containing 1:80000 adrenaline.Once the site was anesthetized all the teeth were extracted i.e. 41,42, 43, 44,45, 46,47. Once the extraction is done, horizontal incisions were given to connect all the extraction sockets.All the extraction sockets were then curetted with the curette no. #1,2, #3,4 to remove the granulation tissue. Flap was thinned using castroveizo scissor. Bone was smoothened with bone file to remove any sharp bony spicule.10 ml of blood was drawn from the antecubital vein from the patient to prepare PRF.Two PIVOT implants were placed in the 44, 46 regions. Particulate xenograft bone grafting was done. Bone graft was secured with PRF, it was covered with collagen membrane which was cut into two halves so that whole quadrant can be covered after the anterior and posterior extent of reconstruction of 4th quadrant and contralateral segment was planned to rehabilitate the whole mandible for future prosthetically driven prosthesis and then secured at place with sutures (3-0 silk sutures)

Post-operative

Patient was asked to take soft liquid diet and not to spit forcefully. Patient was asked to drink juice without straw or to eat ice cream after 1 hour. Oral hygiene instructions were given, chlorhexidine mouthwash 0.12% was given BD for 14 days Patient was given antibiotic coverage Amoxicilav 625mg TDS for 5 days, anti-inflammatory ketorol DT TDS for 3 days was given. Patient was recalled next day and on 7th day for follow up. Sutures were removed on 14th day. Patient was recalled after 1 month of surgery and OPG was taken

Figure No.1a

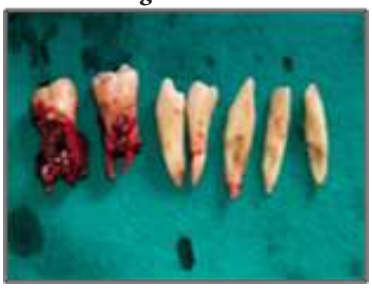

Figure No.1b

Figure No.1c

Figure No. 1d

Figure No.1e

Figure No.1f

Figure No. 1g

Figure No.1h

Figure No.1i

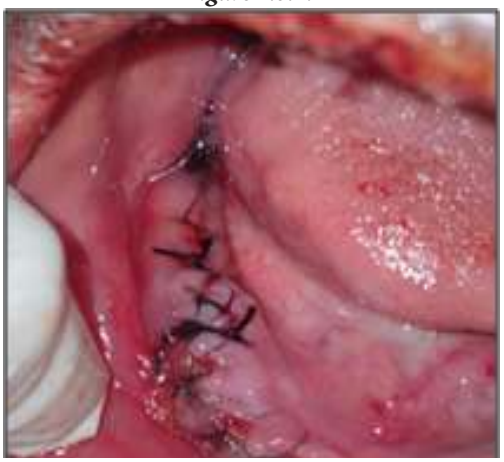

Figure No.1j

Figure No. 1k

Fig-1a preoperative intraoral photograph, Fig-1b probing depth,* Fig-1c extracted teeth from 4th quadrant, Fig-1d horizontal inci*sion, Fig-1e particulate bone graft, Fig-1f particulate bone grafting in the extracted region, Fig-1g PRF, Fig-1h bone graft covered with PRF, Fig-1i collagen membrane secured over PRF, Fig-1j suturing, Fig-1k post-operative OPG.

Figure No.2: Post operative radiograph after 6 months

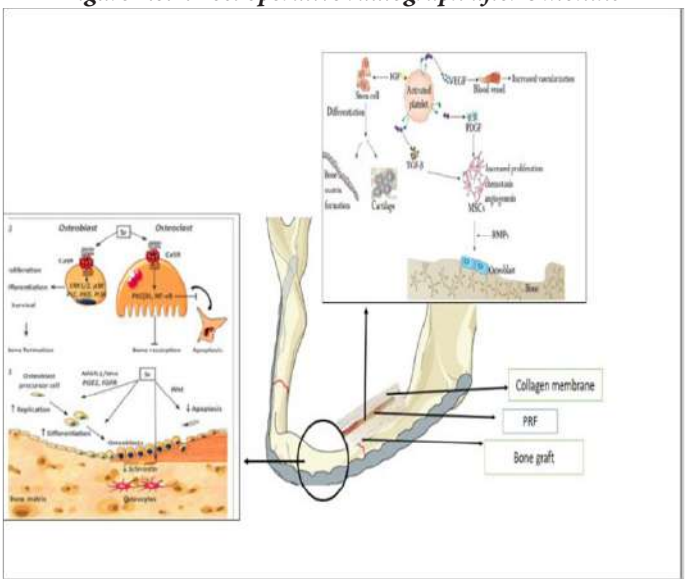

Figure No.3: Biologic dynamism of bone orchestratum

Figure No.4 Host bone, particulate bone graft, PRF and collagen membrane resulting in "ORCHESTRATED BONE"

PRF an autologous osteoinductive second-generation platelet concentrates in source rich in leukocytes & cytokines. With the gradual release of vascular endothelial growth factor and transforming growth factor (TGF) in the orchestration environment they polymerize and form three-dimensional structure with platelet cytokines which is entrapped in fibrin mesh which is crucial in provisional matrix formation and osteoblastic activity. It has direct effect on proliferation and differentiation of osteoblasts for osteoconduction. Thus development of cells and extracellular matrix may support new bone formation in the Orchestration differentiation and maturation

Conclusion

There are many techniques that exist for effective bone augmentation. These approaches largely dependent on the extent of the defect and specific procedures to be performed for the implant reconstruction. Various biomaterials can be used to augment bone for implant placement. No single biomaterial or clinical technique is ideal, and the clinicians need to decide the suitable approach which can provide suitable results with less complication. Each graft procedure has advantages and disadvantages and should use the material with a high success rate and less morbidity. It is most appropriate to use an evidenced-based approach when a treatment plan is being developed for bone augmentation cases.

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FIXED FUNCTIONAL APPLIANCES- A REVIEW

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Abstract

Class II malocclusion is one of the most common malocclusion in orthodontic patients seeking orthodontic treatment and it occurs in about one third of population. In growing patients skeletal discrepancy can be corrected by using removable and fixed functional appliances. These appliances are capable of altering direction and amount of growth of individual. Use of removable appliances needs patient compliance for their effectiveness. So to make these appliances non dependent on patients, fixed functional appliances were introduced. This review will discuss the history, classification, indications and skeletal/dental effects of fixed appliances.

Keywords: Functional appliance, Mandible, malocclusion, camouflage.

Introduction

Class II malocclusion is one of the most common malocclusion in orthodontic patients seeking orthodontic treatment and it occurs in about one third of population. Class II malocclusion may be due to skeletal or dental factors. Skeletal class II malocclusion may be due mandibular retrusion, maxillary protrusion or combination of both. But most common component in class II patients is found to be mandibular retrusion.[1]

In order to treat the full spectrum of malocclusions effectively, a clinician must recognize and assess such developing skeletal pattern at an early age. If conservative orthodontic therapy cannot be provided at appropriate time, then such skeletal malocclusions become worse and may have to be treated with surgical treatment or camouflage orthodontic treatment.[2]

Class II patients with retrognathic mandible, the ideal treatment is aimed to alter the amount or direction of growth of mandible for correcting malocclusion. This can be achieved with Functional appliances including removable and fixed devices that are capable to change the position of the mandible, both sagittal and vertical direction and also can do supplementary lengthening of the mandible.[1]

The functional appliances are "those removable or fixed appliance that alters the posture of mandible and transmits the force created by the resulting stretch of the muscle and soft tissue and change of neuromuscular environment to the dental and skeletal tissues to produce movement of the teeth and modification of growth"[3].

Initial removable appliances were bulkier and inconvenient and patient compliance was poor with these appliances. It was difficult for patients to carry out normal functions like speaking and mastication after wearing theses appliances. Furthermore, intermittent wear does not elicit continuous muscle activity, which is very much needed for promoting the skeletal change[4]

Failure to adhere to prescribed schedule by patient, usually seen with removal appliances resulted in slow treatment response or some time no response at all. Therefore successful orthodontic treatment with removable functional appliances was dependent on patient cooperation in wearing of the appliance. Also the treatment time with the removable functional appliance was around one and one-half years, which was long enough to promote non – compliance and burnout.

To avoid these problems of removable functional appliances, fixed appliances were introduced. Fixed functional appliances are those functional appliances that are fixed to the upper or lower jaws and which cannot be removed by the patient.

Origin of fixed functional appliance was started with Emil Herbst's introduction of his appliance for the temperomandibular joint patient in 1905.3 This appliance was reintroduced by Hans Pancherz of Malmo, Sweden in 1979, which actually showed the potential of this appliance in stimulating the mandibular growth.[3]

Development of such appliances was aimed in eliminating the need for patient compliance and placing treatment outcome under the control of clinician. With fixed functional appliances, the treatment duration was reduced to around 6 months. Beside this faster result, it became possible to use the advantage of growth modification treatment in those unfortunate patients who were near the completion of growth and were unable to take treatment during early mixed dentition period .

History of appliances

The first ever fixed functional appliance was introduced by German professor **Emil Herbst[3]**, at the international dental congress in Berlin in 1905. Infact the appliance was originally recommended for disorders of temperomandibular joint.

Herbst (1934)[3] presented a series of article in the "**Zahnartzliche Rundschau"** based on his experiences with the appliance. After that, however very little literature was published on the subject and the treatment method was more or less forgotten.

Baume LJ, Derichsweiler H (1960)[5] using fixed inclined planes in young monkeys observed condylar head assuming a prolonged bilobed shape and increased cartilage proliferation resulting in increase of length of mandible.

The honour of reintroducing Herbst appliance goes to **Hans Pancherz (1979)[3]** of Malmo, Sweden. He called attention of the orthodontic society to the possibility of stimulating mandibular

growth by "jumping the bite" with the help of Herbst appliance. Using Herbst appliance, **Hans Pancherz** showed that Class II correction could be treated successfully in 6 months, without patient cooperation. Sagittal mandibular growth was increased by treatment and contraction of muscles change towards normalcy.

Langford NM Jr (1981)[6] wrote about the modification in Herbst appliance to reduce pushing forward of lower anteriors. He used the full lingual arch which prevents the pushing of the lower anteriors forward, which was a problem mentioned by Dr. Pancherz. He also observed for expansion of the upper first premolars, if a full upper lingual arch is not used. This is due to the rotation of the molar during treatment, which causes premolar expansion via the sectional lingual bars. Upper anterior brackets and an archwire from premolar to premolar can be used to control this expansion

Raymond P.Howe (1982)[7] introduced the bonded Herbst appliance to overcome some of the problem encountered with earlier designs. The principle difference between the original and proposed appliance design is that the paired telescoping elements, which had been attached to the lower bicuspid bands, are now attached to the entire lower dental arch by an acrylic bite splint.

Coelho Filho (1995)[8] introduced the mandibular protraction appliance (MPA) for class II treatment. Initially he introduced MPA 1 and MPA 2.

Calvez X (1998)[9] presented the universal bite jumper. It can be used in mixed or permanent dentition. It can be used in class III patients by mounting it in a reverse configuration.

D.D.Guner et al (2003)[10] evaluated the effect MARS on temporomandibular joint using single photon emission computerized tomography.

Meanwhile, James J Jasper (1987)[11] developed a new and more flexible fixed functional appliance that allow lateral movements, the Jasper Jumper (JJ).

West R.P (1995)[12] had deviced the Adjustable Bite Corrector. It is stretchable closed coil spring. The push force is generated by a nickel titanium wire in the center of lumen of the spring. Its advantage is that it can be used on either side left or right.

Devincenzo J (1997)[13] introduced a new interarch force delivery system, the Eureka spring. Better patient cooperation and enhanced esthetic because of reduced size are the major advantages claimed besides reducing cost and inventory.

Klapper Lewis (1999)[14] introduced the super spring II in non compliant class II patients.

Thus the fixed functional appliance has undergone various modifications by the hands of talented clinicians, they have tried to use the concept in a way suitable to their existing practising system of orthodontics.

Classification of Fixed Functional Appliances

Ritto's classification[15,16]

I) Flexible Fixed Functional Appliances (FFFA)

1) Jasper Jumper
2) Amoric Torsion Coils
3) Adjustable Bite Corrector
4) Scandee Tubular Jumper
5) Klapper Super Spring
6) Bite Fixer
7) Churro Jumper

II) Rigid Fixed functional appliances (RFFA)

1) Herbst Appliance
2) Cantilevered Bite Jumper
3) MALU Herbst Appliance
4) Flip-Lock Herbst Appliance
5) Ventral Telescope
6) Magnetic Telescopic Device
7) Mandibular Protraction Appliance
8) Universal Bite Jumper
9) BioPedic Appliance
10) Mandibular Anterior Repositioning Appliance
11) IST – Appliance
12) Ritto Appliance

III) Hybrid Appliances

1) Calibrated Force Module
2) Eureka Spring
3) Twin Force Bite Corrector
4) Forsus – Fatigue Resistant Device
5) Alpern Class II Closers

Moschos A. Papadopoulos's classification[17]

Appliance	Author
(A) Rigid intermaxillary appliances (RIMA)	
1) Herbst appliance	
• Banded Herbst design	Pancherz (1979)
• Cap Splint Herbst design	Pancherz (1997)
• Stainless Steel Crown Herbst design	Langford (1982), Dischinger (1989)
• Acrylic Splint Herbst design (cemented or bonded)	Howe (1982)
(removable)	Howe (1987)
(upper bonded and lower removable)	McNamara (2001)
• Goodman's modified Herbst	Goodman and McKenna (1985)
• Upper Stainless Steel crown And lower acrylic	Valant (1989)
• Flip- Lock Herbst design	Miller (1996)
• Hanks Telescoping Herbst design	Hanks (2003)
• Open bite intrusion Herbst design	Dischinger (2001)
2) Mandibular Advancing Repositioning Splint (MARS)	Clement and Jacobson (1982)
3) Cantilever bite jumper (CBJ)	Mayes (1996)
4) Molar moving Bite Jumper (MMBJ)	Mayes (1998)
5) Mandibular Corrector Appliance (MCA)	Jones (1985)
6) Mandibular Protraction Appliance (MPA)	
Type I	Coelho Filho (1995)
Type II	Coelho Filho (1997)
Type III	Coelho Filho (1998)
Type IV	Coelho Filho (2001)
7) Mandibular Anterior Repositioning Appliance (MARA)	Eckhart (1998)
8) Ritto Appliance	Ritto Orthod Cyber-J Archives
9) Functional Mandibular Advancer (FMA)	Kinzinger (2002)

(B) Flexible intermaxillary appliances (FIMA)

1) Jasper Jumper — Jasper (1987)
2) Scandee Tubular Jumper
3) Flex Developer (FD) — Winsauer (2002)
4) Amoric Torsion Coils — Amoric (1994)
5) Adjustable Bite Corrector — West (1995)
6) Bite Fixer — Awbrey (1999)
7) Gentle Jumper
8) KlapperSuperspring II — Klapper (1999)
9) Churro Jumper — Castanon (1998)
10) Forsus Nitinol Flat Spring — Heinig&Goz (2001)
11) Ribbon Jumper

(C) Hybrid appliances (combination of RIMA and FIMA)

1) Eureka Spring — DeVincenzo (1997)
2) Sabbagh Universal - Spring (SUS)
3) Forsus Fatigue - Resistance Device
4) Twin Force Corbett and Bite Corrector Molina (2001)

Indications of fixed functional appliances:[18]

- The correction of skeletal abnormality in young growing individuals including skeletal class II with retrognathic mandible and skeletal class III with maxillary retrusion.
- To use of the residual growth left in neglected post adolescent patients who have already passed the maximal pubertal growth.
- In adult patients, these appliances can be used for:
- Distalization of the maxillary molars to correct dental class II molar relationship.
- Enhancing anchorage.
- As a mandibular anterior repositioning splint in patients having temporomandibular joint disorders.
- Conditioning of muscles in presurgical stage in patients with class II malocclusion.
- Post surgical stabilization of class II / class III malocclusion

Skeletal and dental effects of appliances

Functional Jaw Orthopaedic treatment responds well in actively growing individuals. In 1979, Panchrez performed a cephalometric evaluation of class II patients treated with Herbst appliance by jumping the bite. Treatment duration was 6 months and findings were[19]:

- Achievement of normal occlusion in all patients;
- Slight reduction in SNA indicating maxillary growth restriction or redirection;
- Increased SNB showing greater than average mandibular growth;
- Increased mandibular length supportive of condylar growth stimulation;
- Reduction in hard and soft tissue convexity[19]

Pancherz H and Anehus-Pancherz M. [20] investigated the effect of continuous bite jumping on masticatory muscle activity using EMG records , in Class II division 1 malocclusion treated with the Herbst appliance . It was reported that EMG activity before treatment for masseter muscle was less than the temporalis muscle. With Herbst appliance, the mandible was jumped forwardly to an incisor edge to edge position with no occlusal contact in posterior area. Increase in EMG activity was observed, increase seen greater in masseter and than temporalis muscle due to change in sagittal jaw base/ dental relationship after six month of treatment with this appliance.

Wieslander L [21] did intensive treatment of severe Class II malocclusion in early mixed dentition using a special headgear-herbst appliance. The treatment duration was for 5 months. Results of treatment revealed:

Change in sagittal relation of 7.5mm. The posteriorly directed impact on the maxilla was seen about 3.1 mm which is due combined effect of distal movement of the dentoalveolar arch and of distal translation of maxilla. The anteriorly directed effect upon the mandible of 4.4 mm was mainly due to anterior movement of the basal part of that bone, with a small part resulting from labial movement of the lower incisors.

It was reported that the displacement resulting from fixed functional appliances was mainly dentoalveolar in nature. There is forward and downward displacement of lower incisors which is the most pronounced dentoalveolar effect of these appliances followed by mandibular molar displacement. The mandible is rotated in the forward and downward direction, but maxillary dentition showed posterior and superior displacement. [22]

The Jasper Jumper and the Herbst appliances are effective in maxillary anterior displacement restriction. In addition to this, the Jasper Jumper was also found to be more effective in restricting the increased effective length of maxilla.[23]

Jasper Jumper, Herbst and MPA appliances were used to stimulate and/or redirect mandibular growth, but no significant difference was observed between the experimental and control individuals in relation to the mandibular length. Therefore, these appliances do not seem to significantly influence mandibular growth.[24,25]

The MPA produced significantly greater palatal inclination in relation to the control group.[23] This could be actually consequent to the appliance effect and/or also to the non-significantly greater labial inclination and protrusion of the maxillary incisors in this group. This result is commonly seen during the use of fixed functional appliances.[26-28] But, the Herbst appliance produced significantly greater protrusion of the maxillary incisors than the control group.

Jasper Jumper and Forsus appliance, both are effective in correction of class II malocclusion. These appliances produce restriction of maxillary growth, improve maxillomandibular relationship, overjet, overbite and molar relationship. They also induce clockwise rotation of occlusal plane, restrict vertical maxillary molar development, intrusion of mandibular molars and retrusion of upper lip.[29]

Woodside DG, Metaxas A, Altuna G[30] found significant changes in the glenoid fossa following Herbst therapy in growing monkeys. He observed the formation of large volume of new bone in anterior border of post glenoid spine and resorption along the posterior border of spine. He observed thickening of articular disc which stabilizes the anterior condylar displacement.

Conclusion

Fixed functional appliances are effective in the management of Class II malocclusion.

These appliances are the only successful bite-jumping treatment for noncompliant, postpubertal patients that does not require orthognathic surgery at a later stage. Fixed functional appliances

are reported to correct Class II skeletal problems by encouraging mandibular growth and by inducing dentoalveolar effects. The changes in the condyle caused by these appliances are assumed to be a result of mechanical stimulus of the fibrocartilage layer of the condyle, such as for long bones with similar structure. Thus the stress from fixed functional appliances should be studied to further explore the association with morphologic changes of the dentoalveolar complex. So that maximum benefit of these appliances can be provided to patients for correcting their malocclusions.

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IS ORTHODONTIC TREATMENT PREDISPOSING FACTOR FOR TEMPEROMANDIBULAR JOINT DISORDERS: A REVIEW

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Abstract
The association between orthodontic treatment and temporomandibular disorders has always been of great interest to oral health professionals. Temporomandibular disorders have been quite prevalent in children and adolescents. Moreover, about 30 per cent of the population receive orthodontic treatment during this period. In this context, the issue of orthodontic treatment may be a predisposing factor for the occurrence of temporomandibular disorders has been raised. Lack of obvious evidence to the assumption that orthodontic treatment is associated with the occurrence of temporomandibular disorders promotes the need for extensive follow-up studies representing broader population sample and more rigorous methodology encompassing all confounding factors in relation to temporomandibular disorders.
Keywords: Temporomandibular Joint Disorders, Orthodontic Treatment, Orthodontics, Mandibular Condyle.

Introduction
The issue of relationship of temporomandibular disorders (TMD) and orthodontic treatment has been explored for many years by researchers; this association has always been of great interest to the oral professionals.[1-7] TMD has been quite a common condition, which is being prevalent in children and adolescents. Moreover, about 30 per cent of the population receive orthodontic treatment during this period. In this context, the issue of orthodontic treatment may be risk factor for occurrence of TMD has aroused.[7-11] The findings in relation to TMD may have clinical implications and can have a profound effect on health and quality of life of patients. The present literature review was undertaken with the purpose to confirm about whether the association exists between TMD and orthodontic treatment.

MATERIALS FOR REVIEW

For this systematic review, the literature search was done in Pub med, Medline and Google databases using the keywords as 'Temporomandibular joint disorders and orthodontic treatment, temporomandibular joint disorders or orthodontics' for the period 1980 to 2015, 91 articles could be retrieved, However only 38 were relevant to the theme chosen. Out of this, were 27 original articles, 9 were review and 2 were case reports. The study subjects were in the age range of 9- years including both the genders. (Table 112-19 ,Table 220-26 , Table 327-31) Previously, many reviews were conducted to estimate the possible association between TMD and orthodontic treatment which had variable interpretations about the literature.

Initially, Greene CS32, 1981, in his review work inferred that occasional clicking may be seen in orthodontically treated patients. The two assumptions that the orthodontic correction of malocclusion may reduce the likelihood of development of TMD or may be therapeutic for those who have developed TMD, were discussed in his review work. Later, Tallents RH et al., 19904 in his review dealt with etiology of the temporomandibular joint (TMJ) problems and found it quite debatable. He postulated that orthodontic therapy neither accelerates nor hinders the development of mandibular dysfunction, in turn, the TMD. McNamara JA et al33, 1995, has reviewed the literature on the interaction of functional and morphologic occlusal factors and orthodontic treatment in relation to TMD. It was concluded that the prevalence of TMJ signs and symptoms increases with age, and they occur in a population otherwise. Hence the TMD that originates during orthodontic treatment may not be associated with treatment. It was also mentioned that extractions of teeth or type of mechanics used for treatment do not elevate the risk of TMD. However, the author advised that the future research may be targeted at the complete understanding of occlusal factors to manage TMDs as although minor it needs to be explored. The systematic review of the randomized controlled trials on the role of occlusal adjustment in the temporomandibular disorders in adults inferred that the occlusal adjustments do not have the role in prevention or treatment of TMD.[9] Luther F reviewed the literature relating TMD with orthodontic treatment as well as malocclusion. It appeared to him that the treatment or malocclusion had little role in worsening or precipitating TMD. Contrarily, some longitudinal studies showed the reduction in TMD signs in orthodontically treated subjects.[10-11] They mentioned about the inadequacy of literature on long-term studies investigating a functional occlusion following orthodontic treatment.[10-12] The literature reviews mentioned that the assumption of orthodontic treatment leads to or prevents TMD appears to be ill-founded.[7,37]

Study Year	Type of study/ Sample	Objective of study	Parameters	Findings
Larssonan-dRonerman, 1981	Retrospective 23, 24-28 yrs	Analyze mandibular dysfunction symptoms in treated patients	10 year follow-up	No association between extensive tooth movement & occurrence of symptoms, higher prevalence of symptoms in patients treated with fixed appliances in both jaws than only in one jaw
Tadej et al 1989	Prospective, 100, Adolescent	Study the TMJ changes due to forces applied using functional appliance	Radiographic	Major changes in condyle size during growth occurred in mediolateral dimension than anteroposterior. Condylar size in males was greater than in females
Kundinger KK, 1991	Prospective, 29, Adolescent 13-19y	Evaluate TMJ and jaw muscles after orthodontic treatment in extraction cases	Premolar. Extractions, Electromyographic	There were no significant differences between the control and experimental subjects.
Artun et al 1992	Prospective 29/F--Cl II, 34/F--Cl I, 16.6y	Study the relationship between condylar position & internal derangement of TMJ in treated patients	Radiographic & clinical follow-up, Extraction &non-extraction	%, Few patients developed clicking, Condyles were located more posteriorly in patients with clicking -No difference in extraction & non-extraction cases
Rendell JK et al, 1992	Longitudinal, 451, 18-months	Investigate relationship between orthodontic treatment & TMD	TMJ pain & dysfunction in symptomatic patients	No clear or consistent changes in levels of pain and dysfunction occurred longitudinally during the treatment period
Dib-bets&Weele, 1996	Prospective, 161, Children, 8-15	to study relationship between orthodontic treatment and TMD	20 year follow up	Although signs and symptoms of TMD increased with age. After 20 years neither orthodontic treatment showed a causal relationship with TMD
Peltola, 1993	Prospective 355/M, 613/F, 19-25	assess of condylar variations TMD	Radiographic	Treated students had condylar variations of 21.1% in males and 16.5 per cent in females. No age correlation in frequency of variations, Condylar flattening & subcortical sclerosis were common in treated subjects
Pullinger et al, 1993	logistic regression 44 young	analysis of 11 common occlusal features in controls in 5 TMD groups		The features as intercuspal position, occlusal slide asymmetry, retruded contacts, overbite, overjet, midline discrepancies, missing teeth, molar relationship did not develop TMD
Peltola, 1995	Longitudinal, 625, 4-15.9	examined panoramic radiographic characteristics in mandibular condyles in treated patients	12-year follow-up	osseous changes of the condyle were only detected in 2.2 % and associated with Class II malocclusion. Condylar findings varied greatly during follow-ups. The findings had become more severe in 49% of the subjects, F>M, Condylar findings disappeared in 28%

Table no. 1: Archiving of features of studies conducted in 1981-1995 [24-29]

Study Year	Type of study	Theme/objective	Variables/ parameters	Findings
Katzberg RW et al, 1996	Prospective 102 treated 76 control	to compare prevalence of internal derangement of TMJ	MRI	prevalence of disk displacement in 33% & 77% patients. No link between a history of prior treatment & internal derangement of TMJ
Owen AH, 1998	Retrospective 600 Adolescent	Assess female patients during fixed appliance therapy, those female Class II malocclusion	--	Patients demonstrating a severe initial overjet, overbite and moderate to severe crowding of the lower arch were most predisposed to developing TMD. Stated the importance of routine X-ray follow-up
Lagerström L1, et al	Prospective 860 19yrs	study the prevalence of signs and symptoms of TMD	questionnaire and clinical examination	Severe signs and symptoms of TMD were rare, the prevalence did not differ between 2 study groups, more common in females than in males
Henrikson T et al, 1999	Prospective 65 females with Class II Adolescent	Investigate the relationship between orthodontic treatment and symptoms and signs of TMD	fixed appliance treatment with straight-wire technique, with or without extractions	Both symptoms and signs of TMD showed considerable fluctuations over 3-year period, with general tendency towards decreasing. TMJ clicking increased slightly over 3 year period.
Yamada K et al 1999	Prospective 23 F 6 M, 18.8-6y	To explore condylar bony changes relate to craniofacial morphology radiographically	Radiographic MRI, CT	Bilateral condylar-change group showed osteophyte formation and erosion commonly, Unilateral condylar change group showed flattening of condyles. Erosion only subjects aged below 19 years. Condylar resorption may be related to a lateral mandibular shift and a retrognathic mandible
Henrikson T1, Nilner M, Kurol J, 2000	longitudinal females 65-Class II 58-unt 60 normal Adolescent	Examine signs of TMD and occlusal changes in Class II malocclusion receiving orthodontic treatment & compare with untreated	---	Temporomandibular joint clicking increased in all study groups over the 2 years, but was less common in the Normal group. The Normal group had a lower prevalence of signs of TMD than orthodontic & untreated Class II groups.
Tahima K et al, 2000,	56 Adolecent	the purpose of this study was to estimate the morphologic features of the craniofacial skeleton in treated adolescent patients with Class III malocclusion	Radiographic-cephalograms chin cup therapy for duration of 3.9 months	Upward-and-forward rotation of mandible, with the forward growth and displacement, is highly associated with unsatisfactory treatment outcomes after pubertal growth in growing Class III patients.

Table no. 2: Archiving of features of studies conducted in 1996-2000 [30-35]

Study /Year	Type of study	Theme	Variables/ parameters	Findings
Conti A et al, 2003,	200 120/F 80/M Cross-sectional 9-20y	evaluated prevalence of TMD (TMJ & muscle palpation, mandibular motion, & joint noise) before and after orthodontic treatment	-Questionnaire -Subjects classified as per TMDs.	The 34% of sample had mild TMD, whereas 3.5% had moderate TMD, higher in females. Joint noises (15.5%) followed by headache (13%) were frequent -TMDs have not shown any relationship with orthodontic mechanics or extraction. -Positive association between TMD and parafunctional habits and emotional tension was found
Shen YH et al, 2005	Case-control 28/F	28-year-old female who underwent orthodontic treatment for 22 months	Radiographic Splint therapy	Clicking commenced 5 months prior to treatment completion along with neck-muscle and right shoulder muscle pain and condylar resorption in later stages. Splint therapy for 1 month has subsided TMD with new bone growth in right condyle
Kinzinger G et al, 2006	Prospective 20-Cl II	Study effects of orthodontic treatment with fixed functional orthopaedic appliances on the disc-condyle relationship in TMJ	Radiographic-MRI	-The treatment does not have adverse effects on initial physiological disc-condyle relationships -TMJs with initial partial or total anterior disc displacement, improved disc position can be achieved.
Cacho and Martinb, 2007	Longitudinal 27-cases-series, 11y	To analyze effect of orthodontic treatment by means of activator appliance on disc-condyle complex	Kinesiographic& sonographic records	No differences in temporomandibular joint sounds before and after treatment, orthodontic treatment with an activator in a child is not a risk factor for the development of TMD or mandibular dysfunction
Egermark&Ronnerman 2007	prospective 50 12.9	investigate development of TMD in active phase of orthodontic treatment.	TMD, headache, bruxism and occlusal interferences examined	The prevalence of TMD was high before treatment. Except for TMJ sounds, signs and symptoms of TMD and headache decreased during the treatment
Rey et al, 2008	Cohort Adolescent & Young	compare class III patients treated with headgear, class I (treated & untreated)	20 year follow-up	No difference in TMD prevalence was found between the 3 groups after 2-3 years.
MacFariane et Al 2009	Prospective Cohort 1981 n=1018 (11-12Y) 1984 n= 792 1989 n= 456 2000 n=337	Explore relationship between orthodontic treatment and TMD	--	Orthodontic treatment neither causes nor prevents TMD, participants with a history of treatment did not have higher risk of new or persistent TMD

Table No. 3: Archiving of features of studies conducted in 2001-2010

TMD and clinical

The prevalence studies on TMDs have reported that approximately 75% of the population has, at least, one sign of joint dysfunction; the signs included joint noises, abnormal jaw movement, or tenderness on palpation.[9] While approximately 33% has, at least, one symptom such as joint pain or facial pain, etc. The commonly observed signs and symptoms of TMD include joint sounds as clicking, pain, spasm of the muscles of mastication and the restricted jaw movements.[9]

It was also observed that the patients occasionally developed TMD or clicking in TMJ during orthodontic treatment which is seen more in an adult population. This was attributed to effects of exceeding adaptive capacity of muscles and joints.[13] The orthodontically treated patients with clicking had more posteriorly placed condyles suggesting the internal arrangements of TMJ.[15] Cacho and Martinb, 200710, evaluated a case-series of 27 symptom-free patients treated using activator. The sonographic study showed no differences in

temporomandibular joint sounds before and after treatment. Henrikson T et al23, 1999 examined 65 patientsduring and post-treatment for TMD, except for TMJ clicking which has increased over a period, there was great fluctuation in symptoms and signs of TMD over the three-year period. The studies evaluated orthodontically treated patients and observed that 34% had mild TMD, and 3.5% had moderate TMD, the joint noises and headache were the most frequent complaints and had female predilection.[25-27]Egermark and Ronnerman11, 2007 investigated the presence of muscle tenderness, headache, bruxism, and occlusal interferences in 50 patients (mean age 12.9 years) before, during and immediately after orthodontic treatment. Except for TMJ sounds, other signs, and symptoms of TMD decreased during the treatment. Although there was a high prevalence of occlusal interferences during treatment, they seemed to have little importance for the development of TMD. Shen YH et al28, 2005 mentioned regarding the case of 28-year-old female who developed clicking sound 5 months prior to completion of 22 months orthodontic treatment. Additionally, she had neck-muscle and right shoulder muscle pain; radiograph revealed right mandibular condylar resorption. The orthodontic treatment was terminated, and the patient was treated with splint therapy, one month subsequent to which the symptoms were subsided, and new bone growth in the right condyle was observed. Accordingly, it is recommended to closely monitor the patient when TMD is noted during active orthodontic treatment. Also, splint therapy may be utilized to treat TMD and any associated bone remodelling.

Peltola et al[5,18] investigated the hypothesis that radiographic condylar findings in treated patients are associated with clinical TMD. The frequency of temporomandibular joint crepitation was higher in treated (27%) subjects than controls (8%). It was suggested that crepitation may be due to osteoarthrosis in the present subjects. Further, 12-year follow-up study showed that although radiographic findings worsen with duration, the subjective symptoms and signs did not seem to cause any significant clinical problems to the patients. Rendell JK et al[16,] 1992, had 2 observations as the asymptomatic patients who underwent orthodontic treatment showed no evidence of signs and symptoms of TMD during treatment. The patients who had signs and symptoms of TMD at the time of their entry showed no consistent and reliable clinical parameters of pain and dysfunction during the treatment. Twenty-year follow-up studies for orthodontically treated patients showed no causal relationship with signs and symptoms of TMD.[15,16]

The observations by Katzberg RW et al[20], 1996 could not show the significant correlation between the internal derangement of the TMJ and the orthodontic treatment. It was inferred in a study that orthodontic treatment performed during adolescence has no significant effect on the initiation and precipitation of TMD later in the patient's life.[17] However, the patients having severe initial overjet, overbite and moderate to severe crowding of the lower arch showed the higher predilection towards developing TMD subsequent to orthodontic treatment; it was observed more in female patients.[18]

TMD and appliance

Larsson and Ronnerman12, 1981, studied the Mandibular dysfunction symptoms in 23 orthodontically treated patients by fixed appliances aged between 24 and 28 years with 10-year follow-up. The patients with fixed appliances in both jaws had a tendency towards higher prevalence of symptoms than having appliance only in the upper jaw. In general, there was no evidence of increased occurrence of mandibular dysfunction symptoms; however, it is advocated to be cautious dealing with the patients given the torque on the molars to avoid mediotrusive interferences. Dibbets and Van der Weele17, 1992, compared TMD in children treated with different orthodontic procedures. Patients were monitored for a 20-year period after the start of orthodontic treatment. Although signs and symptoms of TMD increased with age, after 20 years neither orthodontic treatment showed a causal relationship with signs and symptoms of TMD.

The female patients having Class II malocclusion with significant crowding, overbite and severe overjet at entry showed more susceptibility to develop TMD on fixed orthodontic treatment.12 Henrikson T et al, 1999 treated 65 adolescent girls with Class II malocclusion with fixed appliance using the straight-wire technique. The subjects with pre-treatment signs of TMD of muscular origin were benefited functionally from orthodontic treatment over 3 year period.[19] The 65 patients treated using fixed straight wire appliances were evaluated for the period of 2 years and it was showed that orthodontic treatment does not increase the risk of TMD.25 In a study conducted for 200 patients previously, the extraction protocols and the mechanics used for orthodontic treatment did not show any relationship with occurrence of TMD.[21]

In a study conducted in wistar rats to show the change in the calcified tissues of mandibular condyle caused by abnormal muscle function. To achieve the lateral shift of mandible, the maxillary occlusal splint was fabricated. The study showed that both the mandible and the condyle modified their shape and size as well as the trabecular pattern, during shifting of the mandible to one side as it closed.[38]

The studies verified 11 common occlusal features in 5 temporomandibular disorder groups using different orthodontic techniques (functional appliances class I/II elastics, chin-cup, headgear, activator, fixed or removable appliances), the assumptions that these can be etiological factors for TMD appears to be ill-founded.[10,19,30] While in another study, where the patients were treated using chincup therapy, the patients with the upward-and-forward rotation of the mandible in combination with forward growth are highly susceptible to unsatisfactory outcomes and TMD.[26] Tadej G et al[13], 1989, evaluated 100 cases for TMJ changes due to forces applied using functional appliance. The major changes in condyle size during growth occurred in mediolateral than the anteroposterior dimension.13Kinzinger G et al[29], 2006 and Cacho and Martinb[10], 2007 studied the effects on the disc-condyle relationship of TMJ using fixed myofunctional mechanotherapy in patients with class II malocclusion and observed that the treatment does not have adverse effects on TMJs, rather in patients with anterior disc displacement, the disc position was improved. While Rey et al[30], 2008 studied effects in class III patients treated with cervical headgear, class I orthodontically treated and untreated subjects. No difference in TMD prevalence was found between the 3 groups after 2-3 years.

TMD and extraction

An evaluation of 29 orthodontically treated patients with maxillary and mandibular premolar extractions showed no significant differences in TMD signs and symptoms.[14] In a study by Artun J et al[15] 1992, on 29 female patients treated for Class II, Division 1 malocclusion it was observed that the mean condylar position was more posterior at right central and medial tomographic sections in patients treated with maxillary first premolar extraction.

In a study involving 65 females, it was inferred that the orthodontic

treatment with or without tooth extractions did not increase the risk for TMD or worsen pre-treatment signs of TMD.[23]

Conclusion

Overall, the literature review suggests the lack of clear evidence about the association of orthodontic intervention and TMD. The prevalence of symptoms and signs are shown to be varied according to the criteria used and the methods of data collection. Longitudinal studies showed the increased in occurrence of prevalence of the signs of TMD with age as compared to the symptoms. Owing to the greater prevalence of TMD in children and adolescents, also the higher number of patients in this age group undergo orthodontic treatment, it may appear that orthodontic intervention may be a risk factor for TMD. The various studies have mentioned about the development of signs and symptoms of TMD during and after treatment in the patients who were asymptomatic at the entry. In addition, there is no reliable data to correlate TMD with the type of mechanics used, associated tooth extraction and type of malocclusion in treated patients or whether the severity and prevalence of TMD are influenced by orthodontic treatment. The lack of universal diagnostic criteria for TMD, methodologic shortcomings and variability hampers that any conclusion can be drawn about this association.

On the whole, orthodontic intervention has been cited either detrimental or beneficial factor in regard to the occurrence of TMD. Lack of obvious evidence to the assumption that orthodontic treatment is associated with the occurrence of TMD promotes the need for longitudinal studies with broader representation and more rigorous methodology encompassing all relevant variables or confounding factors in relation to TMD.

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