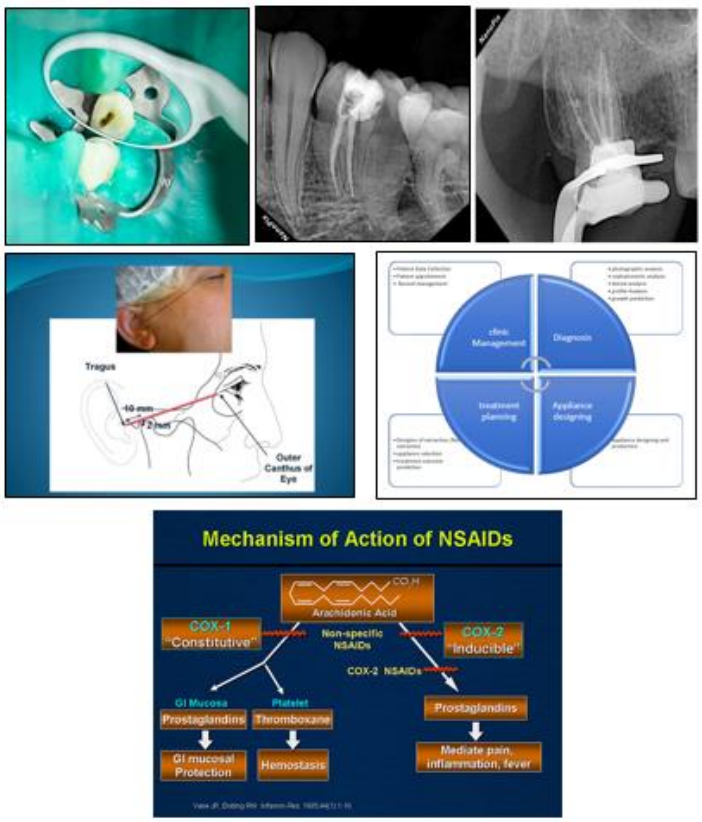
Online ISSN: 2581-5381

MIDSR

Journal of Dental Research



Volume 5
Issue 1
January – June 2023

An Official Publication of
MAEER Pune's
MAHARASHTRA INSTITUTE OF DENTAL SCIENCES & RESEARCH (DENTAL COLLEGE), LATUR.

From the desk of Editor-in-Chief

With immense pleasure I would like to announce that we are publishing the Volume 05 (Issue 01 – Jan - Jun 2023) of MIDSR Journal of Dental Research after the successful publication of three volumes. ***"Everything is possible when you have right people to support"***, I would like to extend my heartfelt thanks to the authors and our management for their constant faith in me and their utter support.

The Volume 05 (Issue 01- Jan- Jun 2023) has been created with the great efforts of providing the quality manuscripts rather than the quantity, the volume contains case reports on clinical approach in the endodontic treatment of Maxillary Third Molar with MB2 canal and bifid root with mandibular first premolar. Also, review articles on Evaluation of Bupivacaine, Orthodontic Pain Management, Revolution of Artificial Intelligence and Benefits of Smileloc Abutment System.

I dedicate this issue to all the faculty members of MIDSR Dental College, Latur who immediately responded to the call for manuscripts and submitted their valuable work to the Journal.

Dr. Suresh K. Kangane,
Principal,
MIDSR Dental College, Latur.

Table of Contents

Original Research

A Comparative Evaluation of Push-Out Bond Strength of Two Different Posts System To Root Dentin By Using Two Different Luting Cement -An In Vitro Study

Dr. Pooja Kendre [1], Dr. Amol Badgire[2], Dr. Ramchandra Kabir[3], Dr. Anita Kale[4], Dr. Praveen Dhore[5], Dr. Madhuri Agrwal[6]
[1]PG Student, [2]Professor, [3] Professor & HOD, [4] Professor, [5,6]Reader
Dept. of Endodontics, MIDSR Dental College, Latur.

Abstract:

Background: Posts that have been properly fitted can withstand torsion forces and so provide better retention. Objectives: The purpose of this in vitro study was to comparative evaluation of push-out bond strength of two different posts system to root dentin by using two different luting cement. Materials and Method: A total 25 single rooted mandibular incisors with fully developed apices and straight root canals were selected in the study. The samples were randomly divided into 5 groups of 5 teeth each. The crown down procedure was used to clean and shape the pulp area. A Tenax fiber post and rebilda glass fiber post was used by four groups. The first group is control group (n=5)-Teeth restored without post. Second group (n=5) - rebilda post with vocco (Bifix SE-Quickmix). Third group (n=5)-rebilda post with FC (Filtek Z 350 3M ESPE). Fourth group (n=5)-Tenax fibre post with vocco (Bifix SE-Quickmix). Fifth group (n=5) - Tenax fibre post with FC (Filtek Z 350 3M ESPE). The specimens were cross sectioned after 24 h. all specimens were cross-sectioned 4 mm thick into the coronal and middle parts by a sectioning machine. The strength of the bond between the luting cement and the posts was measured using push out bond strength testing.
Results: In coronal and middle region each, rebilda post with bifix SE group showed significantly higher push out bond strength as compared to other four groups.
Conclusion: Bifix SE with rebilda post mean push out bond strength score is less than other groups.

Keywords: Rebilda post, push out bond strength, bifix SE Quikmix, Tenax fiber post.

Corresponding Author: Dr. Pooja Vaijnath Kendre, PG Student, Dept. of Endodontics, MIDSR Dental College, Latur. Email id.: drpoojakendre12@gmail.com

INTRODUCTION

The main clinical goal of using a post system is to provide additional support and retention to the coronal restoration in endodontically treated teeth with compromised crown structure. For that purpose, different treatment modalities and materials have emerged to maximize the clinical outcomes of biomechanical stability, esthetics and longevity1. Multiple parameters concerning the intraradicular post influence the success of restored endodontically treated teeth. For instance, the adhesion of the post to

the intraradicular dentin and its retention within the radicular structure has an impact on restorative complex durability. Further factors include the amount of remaining tooth structure and post, as well as core and cement material properties.1

One of the main goal of posts presence is to ensure the dental materials' retention while the lost dental crown is being reconstructed. A post allows for the appropriate stress distribution in the root and may be used to support single crowns and bridges. However, according to numerous researchers, a post does not strengthen the tooth structure, it merely provides the appropriate retention for the material used to restore a crown foundation.2

The difficulty of restoring teeth that are endodontically treated has led to a wide range of base restorations. Loss of tooth structure due to endodontic access preparations, caries, and defective restorations makes restoring a pulpless tooth challenging. The length of a post, diameter, design, canal shape and preparation, luting agent, cementation procedure, and other factors all influence post retention. A good adaptation of the post to the root canal (RC) will remain for a long time and tolerate torsion forces. The resin adhesives in well-fitting canals provide good retention. The quality of luting cement is the main element in retention. Characteristics such as easy manipulation, a thinner film, extended working time with a fast set, and low solubility are ideal properties in luting cement. However, there have been fewer studies that provide evidence on the comparison of the bond strength of luting cement. Most studies have conflicting results on which of the luting types of cement have superior bond strength.3

Rebilda glass fiber post is highly translucent for excellent esthetics. High radiopacity (350% Al).Dentin-like elasticity for gentle root treatment and Dentin-like translucency for esthetic restorations with High retention rate for strong bond.Excellent light conduct and diffusion for use with dual-cured materials.it contains Glass fiber-reinforced resin post (Rebilda Post) contains 70% glass fiber, 10% inorganic filler, 20% UDMA matrix.

Tenax glass fiber post it is an excellent alternative to metal posts, if highly esthetic, metal free restorations are desired. This Post System is a high quality, translucent fiber resin post system, that has a tapered (.04) design in the bottom third of the post. High strength, high bending strength, and resistance to shearing force have elastic modulus similar to that of dentin. It is translucent hence light can pass through it while using light cure. Fiber /Glass reinforcement 75% and Resin 25%.

Bifix SE flowable composite secure adhesion to tooth and restoration.Fast working: no etching, no bonding Odourless, Easy handling Long-term durability. Simple removal of excess material Minimal film thickness of 10 µm for precisely fitted luting without elevating the bite. Also suitable for zirconium dioxide. Catalyst: dimethacrylates, phosphoric acid, dimethacrylate ester, methacrylates, BPO, SiO2, BAS glass ceramic, BHT;Base: dimethacrylates, methacrylates, CQ, amine, SiO2 , BAS glass ceramic, BHT; filler content: 66.3%.

Filtek flowable composite Low-viscosity, visible light-cured, radiopaque flowable nanocomposite. Bonding to the tooth structure is accomplished through the use of dental adhesive systems, either total-etch or self-etch, that are designed to be compatible with methacrylate composites. The resin contains bis-GMA, UDMA, TEGDMA, and bis-EMA resins. To moderate the shrinkage, PEGDMA has been substituted for a portion of the TEGDMA resin in Filtek Supreme XT restorative.

The purpose of this study was to evaluate of the push-out bond strength of two different posts system to root dentin by using two different luting cement - an in vitro study

Material and methods

Sample preparation: A total of Twenty five natural single rooted mandibular incisors were used in this study. Selected teeth were extracted due to periodontal problems and the structure of the tooth, i.e., with enamel and dentine intact, so that results can be generalized. Then teeth were cut at the cementoenamel junction, teeth were sectioned with a high-speed airotor handpiece. The endodontic working lengths will be determined visually at 1.00 mm short of the apical foramen, using the 10 K-type files (Maillefer, Ballaigues, Switzerland).The pulp space was cleaned and shaped using the crown-down technique with a rotary protaper nickel-titanium file up to size F2. Irrigation with sodium

hypochlorite 2.5% solution, saline, and 17% Ethylenediaminetetraacetic acid (EDTA) was done at the same time. The RCs were dried with paper points after being irrigated with distilled water. All of the RCs were sealed with endodontic sealer and then gutta-percha was used to obturate them. The teeth were then stored in deionized water for 24 h to create post spaces. The RC walls of the specimen were individually enlarged using low-speed drill tips. The depth of the post space was 10 mm. The specimens were divided into 5 groups of 5 samples each at random.

The samples were randomly divided into 5 groups as follows.

1) Control group (n=5)-Teeth restored without post.

2) Group (n=5) - rebilda post with vocco (Bifix SE-Quickmix).

3) Group (n=5)-rebilda post with FC (Filtek Z 350 3M ESPE).

4) Group (n=5) - Tenax fibre post with vocco (Bifix SE-Quickmix).

5) Group (n=5) - Tenax fibre post with FC (Filtek Z 350 3M ESPE).

In control group-Teeth restored without post.

The RC walls of the specimen were individually enlarged using peeso reamer. The depth of the post space was 10 mm.

Group 2: The RCs were etched for 10s with 37% phosphoric acid, then rinsed with water and dried. A micro brush was used to apply the single-bond universal adhesive to the RCs. After that, the vocco rebilda post was luted with vocco Bifix SE-Quickmix and put into the RC, with the excess resin later removed. Then the components were light cured for 60 s.

Group 3: The RCs were etched for 10s with 37% phosphoric acid, then rinsed with water and dried. A micro brush was used to apply the single-bond universal adhesive to the RCs. After that, the vocco rebilda post was luted with FC (Filtek Z) and put into the RC, with the excess resin later removed. Then the components were light cured for 60 s.

Group 4: The RCs were prepared same like group 2 and Tenax fiber Trans Coltene whaletene post was luted with vocco Bifix SE-Quickmix.

Group 5: The RCs were prepared same like group 3 and Tenax fiber Trans Coltene whaletene post was coated with FC (Filtek Z).

All specimens were cross-sectioned 4 mm thick into the coronal and middle parts by a sectioning machine. The push test was used to calculate the bond strength between the luting cement and post. On the testing machine, the post was loaded with a 1 mm in diameter cylindrical plunger.

Statistical analysis

All Statistical analyses were carried out using spss software. Mean values and standard deviation (SD) were calculated. After normality testing using a one way ANOVA and Independent t test; was run to analyes the means of each group. The Post hoc Tukey test was to make multiple comparisons between all groups the significance level was set at $\alpha<0.05$.

PROGRESS OF TREATMENT

Table- 1 Comparison of push-out bond strength among five groups

Region	Group	Mean	SD	p-value
Coronal	Rebilda+Bifix	4.43	0.02	<0.001*
	Tenex+Bifix	4.19	0.02	
	Rebilda+Filtek C	4.10	0.02	
	Tenex+Filtek C	3.63	0.03	
	Control	0.92	0.02	
Middle	Rebilda+Bifix	4.33	0.03	<0.001*
	Tenex+Bifix	4.06	0.03	
	Rebilda+Filtek C	3.99	0.03	
	Tenex+Filtek C	3.49	0.03	
	Control	0.43	0.02	

One-way ANOVA test; * indicates significant difference at $p\leq0.05$

Table- 2 Pairwise comparison of push-out bond strength among five groups

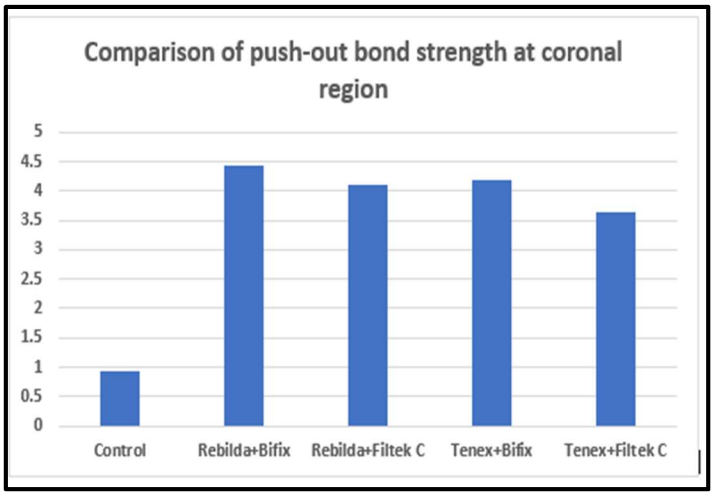
Group	Coronal	Middle
Rebilda+Bifix vs Tenex+Bifix	<0.001*	<0.001*
Rebilda+Bifix vs Rebilda+Filtek C	<0.001*	<0.001*
Rebilda+Bifix vs Tenex+Filtek C	<0.001*	<0.001*
Rebilda+Bifix vs Control	<0.001*	0.002*
Tenex+Bifix vs Rebilda+Filtek C	<0.001*	<0.001*
Tenex+Bifix vs Tenex+Filtek C	<0.001*	<0.001*
Tenex+Bifix vs Control	<0.001*	<0.001*
Rebilda+Filtek C vs Tenex+Filtek C	<0.001*	<0.001*
Rebilda+Filtek C vs Control	<0.001*	<0.001*
Tenex+Filtek C vs Control	<0.001*	<0.001*

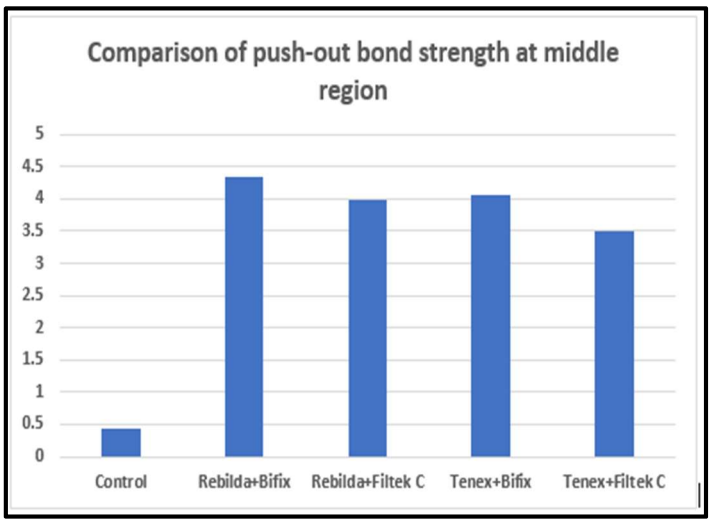
Post hoc tukey test; * indicates significant difference at p≤0.05

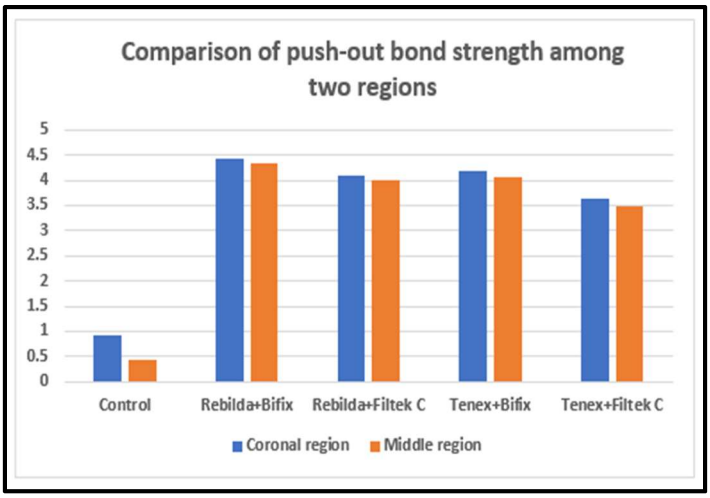
Table- 3 Comparison of push-out bond strength among two regions

Group	Coronal		Middle		p value
	Mean	SD	Mean	SD	
Rebilda+Bifix	4.43	0.02	4.33	0.03	0.001*
Tenex+Bifix	4.19	0.02	4.06	0.03	<0.001*
Rebilda+Filtek C	4.10	0.02	3.99	0.03	<0.001*
Tenex+Filtek C	3.63	0.03	3.49	0.03	<0.001*
Control	0.92	0.02	0.43	0.02	<0.001*

Independent t test; * indicates significant difference at p≤0.05







DISCUSSION

Tooth restoration following endodontic treatment is the main objective of dental prosthetics. It is recommended not to insert posts at the cost of the root dentin.(4) The research has shown that excessive preparation for a post not only weakens the tooth structure but may also lead to fractures and defects which could result in increasing the probability of tooth fractures or even tooth loss.(5,6)

Phebus et al. demonstrated that the teeth with a cemented fibre-reinforced composite post were significantly stronger than those which were endodontically treated without the use of a post.(9)

In the present study, the push-out bonding test has been applied for measuring the bond strengths of posts to intra-radicular dentin. The push-out bonding test has been considered as a reliable method that provides a better estimation of the bond strength of posts than does the conventional shear test.

It has been applied in several recent studies assessing the influence of a range of factors on bond strength of different types of posts and luting agents. (10-11) Advantages of the push-out test, is that the fracture occurs parallel to the dentin–adhesive interface, which makes it a true shear test. Retention of adhesively luted fiber-reinforced posts relies on the strength of the bonding interface between dentinal root canal wall on one hand and the post surface on the other. It is important that the bond strength is sufficiently strong to withstand stresses during functional loading. (1)

The highest bond strength values of FRC posts in combination with other favorable in vitro physical and mechanical properties that have been demonstrated in recent studies supports their clinical use. Especially in teeth with extensive coronal destruction the clinical outcome advantages of fiber-reinforced composite post have been reported. (12)

Bond strength results that influence a performance of FRP in restorations of endodontically treated teeth provide valuable information to predict the clinical outcome and expect decreasing of debonding frequency due to appropriate selection of post type. Nevertheless, the in-vivo survival of FRC posts and debonding occurrence must be further investigated. (1)

In the present study, a statistically significant result was obtained between the Rebilda glass fiber post with Bifix SE and other glass fiber post with Filtek composite.Due to chemical cure there may be high shear bond strength in middle third compared to other dual cure as light penetration in middle third will be less.

When Bifix SE was used for the cementation of zirconium crowns, it was capable of presenting a higher level of retention after one year, with good mechanical properties even after being submitted to stress for a long period. Bifix SE is a cement that is more dependent on chemical activation than on light activation. (7)

With analysis of the Ca 2p peak components, a powerful method to quantify the chemical interaction to HAp was developed and adopted to analyze the reaction of composites with inorganic teeth components. Percentage of unreacted HAp calcium atoms were found and with Bifix 65 and 35%, respectively. (8)

In prefabricated fiber post systems, fiber content usually ranges from about 35% to 65%, with a higher fiber content post typically having greater strength and stiffness. The fibers are bound with resin such as epoxy or polyester resins and their advantages are metal free, aesthetic in nature, and can easily be retrieved in case of endodontic failure. While comparing Tenax and rebilda post both composition is almost same.

CONCLUSION

Within the limitations of the present in-vitro study and based on the results, we can conclude that Bifix SE composite for luting is better than Filtek composite.

REFERENCES

1. Kanzler Abdel Raouf V, Jockusch J, Al-Haj Husain N, Dydyk N, Özcan M. Push-Out Bond Strength Assessment of Different Post Systems at Different Radicular Levels of Endodontically Treated Teeth. Materials (Basel). 2022 Jul 24; 15(15):5134.
2. Bialy M, Targonska S, Szust A, Wiglusz RJ, Dobrzynski M. In Vitro Fracture Resistance of Endodontically Treated Premolar Teeth Restored

with Prefabricated and Custom-Made Fibre-Reinforced Composite Posts. Materials. 2021 Oct 19; 14 (20):6214.
3. Cheruvathoor JJ, Thomas LR, Thomas LA, Shivanna MM, Machani P, Naik S, Al Kheraif AA. Push-Out Bond Strength of Resin-Modified Glass Ionomer Cement and Flowable Composite Luting Systems on Glass Fiber Post of Root Canal. Materials (Basel). 2021 Nov 16; 14 (22):6908.
4. Dietschi, D.; Argente, A.; Krejci, I.; Mandikos, M. In vitro performance of class I and II composite restorations: A literature review on nondestructive laboratory trials-part II. Oper. Dent. 2013, 38, 182–200.
5. Meyenberg, K. The ideal restoration of endodontically treated teeth-structural and esthetic considerations: A review of the literature and clinical guidelines for the restorative clinician. Eur. J. Esthet. Dent. 2013, 8, 238–268.
6. Paolone, G.; Scolavino, S.; Gherlone, E.; Spagnuolo, G. Direct Esthetic Composite Restorations in Anterior Teeth: Managing Symmetry Strategies. Symmetry 2021, 13, 797.
7. Lima DM, Linhares TS, Lima SNL, Carvalho EM, Loguercio AD, Bauer J, Carvalho CN. Effect of Sonic Application of Self-Adhesive Resin Cements on Push-Out Bond Strength of Glass Fiber Posts to Root Dentin. Materials (Basel). 2019 Jun 14; 12(12):1930.
8. Gerth HU, Dammaschke T, Züchner H, Schäfer E. Chemical analysis and bonding reaction of RelyX Unicem and Bifix composites--a comparative study. Dent Mater. 2006 Oct; 22(10):934-41.
9. Phebus, J.G.; Owens, B.M.; de Rijk, W.; Davis, A.; Johnson, W.W. Fracture resistance of permanent anterior incisors using fiber-reinforced composite posts. Gen. Dent. 2014, 62, 37–42.
10. Bouillaguet, S.; Schütt, A.; Alander, P.; Schwaller, P.; Buerki, G.; Michler, J.; Cattani-Lorente, M.; Vallitu, P.K.; Krejci, I. Hydrothermal and mechanical stresses degrade fiber–matrix interfacial bond strength in dental fiber-reinforced composites. J. Biomed. Mater. Res. Part B Appl. Biomater. 2006, 76, 98–105.
11. Kremeier, K.; Fasen, L.; Klaiber, B.; Hofmann, N. Influence of endodontic post type (glass fiber, quartz fiber or gold) and luting material on push-out bond strength to dentin in vitro. Dent. Mater. 2008, 24, 660–666.
12. Baba, N.Z.; Golden, G.; Goodacre, C.J. Nonmetallic prefabricated dowels: A review of compositions, properties, laboratory, and clinical test results. J. Prosthodont. 2009, 18, 527–536.

Bifid Root with Mandibular First Premolar- A Case Report

Dr. Priyanka Kombade [1], Dr. Ramchandra Kabir[2], Dr. Anita Kale[3], Dr. Amol Badgire[4], Dr. Praveen Dhore[5], Dr. Abhishek Badade[6]
[1]PG Student, [2]Professor & HOD, [3] Professor, [4] Professor, [5,6]Reader
Dept. of Endodontics, MIDSR Dental College, Latur.

Abstract:
Understanding the root and canal anatomy is crucial before initiating endodontic procedures. A common cause for non-surgical endodontic treatment failure in mandibular premolars is missed roots or canals, as the root canal morphologies of these teeth can sometimes be atypical. Mandibular premolars have earned the reputation for having an aberrant anatomy. Literature is filled with reports of extra canals in mandibular second premolars, but reports about the incidence of extra roots in these teeth are quite rare. This paper attempts at explaining a rare case of successful endodontic management of a two-rooted mandibular first premolar with diagnostic, inter-operative and postoperative radiographic records along with a substantial data on the incidence of extra roots in these teeth.

Keywords: Endodontics, root canal therapy, two roots, lower first premolar

Corresponding Author: Dr. Priyanka D. Kombade, PG Student, Dept. of Endodontics, MIDSR Dental College, Latur. Email id.: priyankakombade03@gmail.com

INTRODUCTION

The success of root canal therapy is dependent upon a thorough knowledge of the root and root canal morphology. This helps us to locate all the canals and properly clean, shape, and obturate the canal spaces in all dimensions.[1–3] Slowey has suggested that mandibular first premolars, often called as "Endodontist's enigma," may present the greatest difficulty of all teeth to perform successful endodontic treatment.
[4] This is because they are anatomically unpredictable, and often present with a wide variety of morphological rarities. One such morphological oddity is the presence of two roots, with a reported incidence of 1.8%.

Failure to recognize variations in root or root canal anatomy can result in unsuccessful endodontic treatment. Hence, it is imperative that the clinician be well informed and alerted to the commonest possible variations.

CASE REPORT

A 25 year old female patient reported to the department of Conservative Dentistry and Endodontics at MIDSR Dental College and Hospital, with the chief complaint of pain in the posterior left mandibular tooth for the past
1 week. Patient's medical history was non-contributory. Clinical examination revealed a carious left mandibular first premolar. The tooth was tender on percussion. Radiographic examination of the tooth indicated an unusual anatomy of two roots, and also there was widening of the apical periodontium, indicating periapical pathology and the necessity for root canal treatment. (fig.1)

Fig.1 Preoperative radiograph

The clinical examination, radiographic examination and vitality tests led to a diagnosis of acute apical periodontitis of the left mandibular first premolar requiring endodontic therapy. The tooth was anaesthetized by way of left inferior alveolar nerve block using a 2% solution of lignocaine hydrochloride containing 1:80000 adrenaline (Lignox 2% A, Warren, Indoco). Subsequently, the tooth was isolated with a rubber dam. Endodontic access was prepared with a round diamond bur in a high speed airotor handpiece. The pulp chamber was inspected with the aid of a magnifying loupe (Zumax loupes) and a sharp DG 16 explorer was used to locate the canal orifice. After obtaining the canal patency, a #10 K file (Dentsply, Maillefer) was precurved and inserted in a distolingual direction to traverse the canal bifurcation into the second root. A working length radiograph confirmed the presence of a two canals bifurcating in the coronal one third, and coinciding with the separation of the two roots. (fig.2)

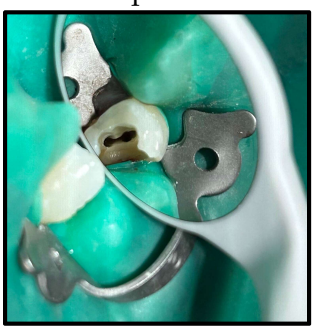


Fig. 1.1 Post caries excavation & access opening

Fig. 1.2 after pre endo buildup

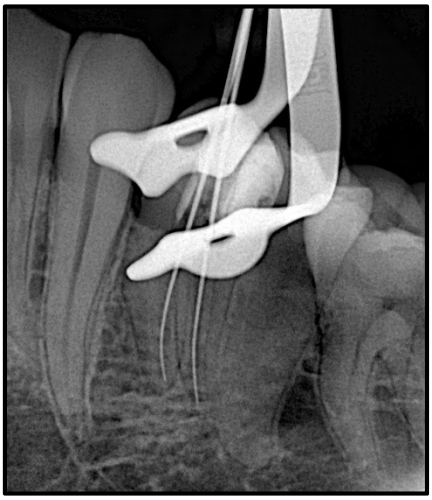


Figure 2. Working length determination

The two canals exited in separate apical foramina located in the respective roots. Cleaning and shaping of the canals was performed using crown-down technique under copious irrigation with 5.25% sodium hypochlorite solution. The canals were dried with paper points, and the tooth was temporized. After three days, the canals were obturated with cold, lateral compaction of gutta percha cones (Dentsply) and resin based sealer after master cone selection. A post obturation radiograph was taken to evaluate the quality of obturation. (Fig. 3 and fig. 4)

Figure.3 Mater cone selection

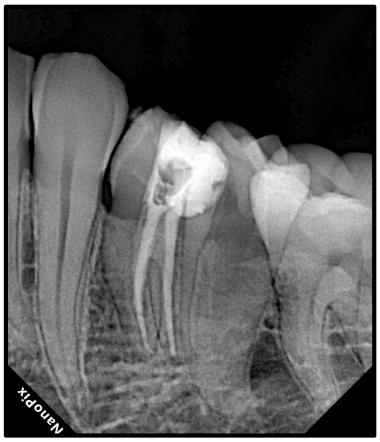


Figure.4 post obturation

DISCUSSION

Anatomical variations, especially extra canals and roots, should always be kept in mind when treating teeth endodontically. Canals if left unclean may harbour microorganisms, which have been reported to be a major cause for treatment failure. [5, 6] A study at the University of Washington assessed the failure rate of non-surgical root canal therapy in all teeth. The mandibular first premolar had the highest failure rate in the study at 11.45%. [7] The root morphology of mandibular first premolar can be highly complex and extra root(s) can be found. Scott and Turner [8] describe the accessory root of mandibular first premolar as Tome's root. They observed ethnic differences in the root morphology; and, reported the highest incidence (>25%) of accessory roots in the Australian and sub Saharan African populations. The lowest incidence of Tome's root (0-10%) occurred in the American, Arctic, New Guinea, Jomon and Western Eurasian populations. Sert and Bayrili[9] also reported sex differences in canal morphology, reporting higher incidence (44%) of accessory roots and canals in females as compared to males (34%). Thus, a variety of factors contribute to variations in root anatomy of mandibular first premolars. Successful endodontic outcome in such cases is dependent upon careful use of all the available diagnostic aids to locate and treat the entire root canal system. Careful interpretation of angled radiographs, proper access preparation and a detailed exploration of the tooth are essential prerequisites for a successful treatment outcome.

CONCLUSION

This case report emphasizes on the importance of thorough knowledge of the internal root canal anatomy and execution of the modified techniques by the clinician before and during treatment to prevent their subsequent flare up. Advanced equipment, for example, dental operating microscope, NiTi file systems, ultrasonics, newer obturating system, etc., contribute to successful endodontic treatment. Aberrant anatomical variation if misdiagnosed leads to failure and if diagnosed correctly leads to successful treatment.

REFERENCES

1. Ingle JI. A standardized endodontic technique utilizing newly designed instruments and filling materials. Oral Surg Oral Med Oral Pathol. 1961; 14:83–91. [PubMed] [Google Scholar]
2. Ingle J, Beveridge E. Endodontics. 2nd ed. Philadelphia: Lea and Febiger; 1976. [Google Scholar]
3. Walton R, Torabinejad M. Principles and practice of endodontics. 2nd ed. Philadelphia: W B Saunders Co; 1996. [Google Scholar]
4. Slowey RR. Root canal anatomy. Road map to successful endodontics. Dent clin North Am. 1979; 23:555–73. [PubMed] [Google Scholar]

5. Molander A, Reit C, Dahlen G, Kvist T. Microbiological status of root filled teeth with apical periodontitis. Int Endod J. 1998; 31:1–7. [PubMed] [Google Scholar]
6. Sundqvist G, Fidgor D, Persson S, Sjogren U. Microbiologic analysis of teeth with failed endodontic treatment and the outcome of conservative retreatment. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998; 85:86–93. [PubMed] [Google Scholar]
7. Ingle J, Bakland L. Endodontics. 5th ed. Hamilton: B C Decker; 2002. [Google Scholar]
8. Scott R, Turner C., 2nd. The anthropology of modern human teeth. Cambridge: Cambridge University Press; 2000. [Google Scholar]
9. Sert S, Bayirili GS. Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. J Endod. 2004; 30:391–8. [PubMed] [Google Scholar]

Endodontic Management of Maxillary Third Molar with MB2– A Case Report

Dr. Yogesh Chanchalwad [1], Dr. Anita Kale[2], Dr. Ramchandra Kabir[3], Dr. Amol Badgire[4], Dr. Praveen Dhore[5], Dr. Shital[6]
[1]PG Student, [2]Professor, [3] Professor & HOD, [4] Professor, [5] Reader, [6]PG Student
Dept. of Endodontics, MIDSR Dental College, Latur.

Abstract:
The endodontic treatment of maxillary third molar often poses a challenge even to an experienced endodontist because of their most posterior location in the dental arch, aberrant occlusal anatomy and abnormal root canal configuration and eruption patterns. Owing to these anatomical limitations, their extraction remains the treatment of choice for many clinicians. As we know, retaining every functional component of the dental arch is of prime importance in contemporary dental practice. This clinical case report aims to discuss the endodontic treatment of maxillary third molar with MB2 root canal.

Keywords: Endodontic treatment, Maxillary third molar.

Corresponding Author: Dr. Yogesh B. Chanchalwad, PG Student, Dept. of Endodontics, MIDSR Dental College, Latur. Email id.: yogeshchanchalwad1409@gmail.com

INTRODUCTION

Despite the increased awareness amongst the patients, maxillary third molars always are prone to develop tooth decay owing to their most inaccessible location in the arch and wrinkled occlusal anatomy which would favour the accumulation of the plaque and interfere with optimum cleaning. Besides, they usually have the abnormal eruption patterns, which also make them susceptible to dental decay. Owing to these complications, the extraction of the third molar is the usual choice for all practitioners unless the tooth is strategically important. Retaining every functional component of the dental arch, including the third molars, is the principal goal of contemporary dental practice. In certain clinical situations retaining such teeth is even more important if they are to serve as the convenient abutment for fixed prosthesis.

The root and root canal morphology of maxillary third molars show an increased likelihood for aberrations either in number of roots or the canal configuration. The number of roots in maxillary third molar teeth ranges from one to five and number of encased root canal has been reported from one to six. However, the single, double and three rooted variants, either separate or fused, encasing one to four root canals are considered most common. The internal anatomy of the mesiobuccal (MB) root in maxillary third molars has been investigated more than any other root. However, few studies examined the occurrence of second mesiobuccal canal (MB2) in third molar teeth. In 1999, Stropko evaluated the endodontic treatment of 20 maxillary third molar teeth, and found only 20% of the study subjects having a MB2 in which all of them were joined and ended in a single foramen [1].

CASE REPORT

A 40-year-old female reported to the department of conservative dentistry and Endodontics at MIDSR Dental College and Hospital, with a chief complaint of food impaction and pain in the last right upper molar region. The pain started a month ago and was dull, gnawing in nature with moderate intensity. On

clinical examination, it was observed that the maxillary right third molar had a deep mesioproximal and occlusal caries with an exposed pulp. The tooth was severely tender on percussion and had moderate pain on palpation. Pulp testing with electric pulp tester (Parkell Inc. Edgewood, NY, USA) elicited non-responsiveness from the suspect tooth.

By evaluating the tooth clinically, radiographically and a diagnosis of pulpal necrosis with an acute apical periodontitis was made and an endodontic approach was planned for this tooth. Rhomboidal shape access was made to gain entry to the pulp chamber after administration of local anaesthesia (2% lignocaine with 1:1, 00000 epinephrine). Placement of rubber dam for isolation was not possible owing to poor accessibility. The mesial marginal ridge was infringed upon to achieve enough access to reveal the mesially positioned and mesially inclined MB2canal. Slow-speed Mueller burs (Brasseler, Savannah, GA, USA) was used with a brushing motion between the MB and the palatal canal orifice to remove the dentinal shelves that overlay the anticipated MB2 canal orifice using intermittent irrigation with 5.2% sodium hypochlorite (NaOCl) solution.

An ultrasonic nonactive tip with active lateral part Start-XTM #2 (Dentsply Maillefer) was introduced at medium speed and with light force along the MB sub-pulpal groove extending palatally from the main MB canal orifice, with continuous water irrigation. MB2 orifice was located. After locating the MB2 orifices, the patency of all the four root canals was checked with #10 K file (Kerr USA). The working length was determined by Root ZX II (J. Morita, Kyoto, Japan) apex locator for all the four root canals and confirmed by a radiograph. The root canals were cleaned and shaped by rotary nickel-titanium ProTaper instruments (Dentsply, Maillefer). The canals were sequentially irrigated using

Figure 1. preop radiograph

5.2% NaOCl and 17% ethylyne diamine tetraacetic acid (EDTA) during the cleaning and shaping procedure. Selected master GP were placed in all the canals and a radiograph was taken to evaluate the fit (Fig. 3). The canals were thoroughly dried and were coated with resin-based sealer (Dentsply Maillefer). Obturation was carried out using the ProTaper GP points. Immediate post obturation radiograph showed well obturated root canals. (Fig. 4)

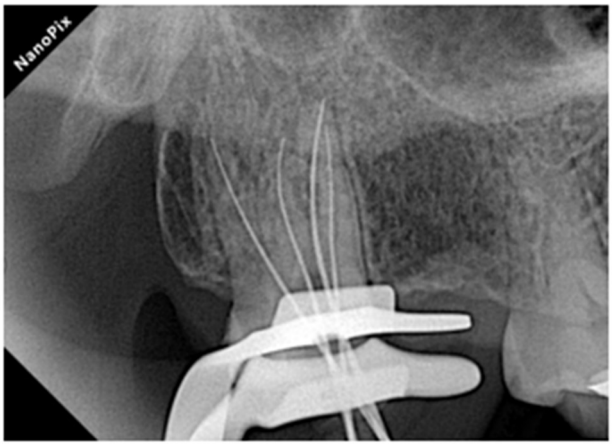


Figure 2. Working length determination

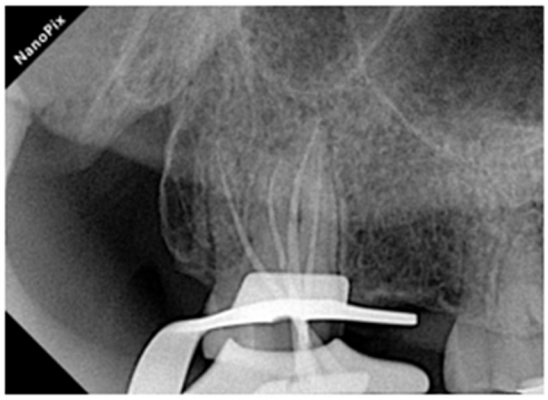


Figure 3. Master cone selection

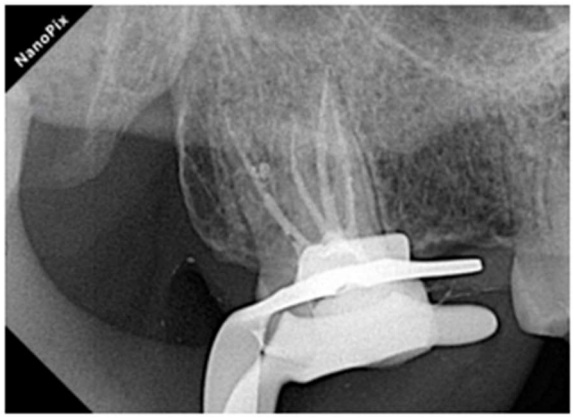


Figure 4. Post obturation

DISCUSSION

The maxillary third molar has one of the most complex root and canal anatomy. The presence of a MB2 canal in the MB root of the maxillary third molars has been the subject of many discussions and studies. An inability to detect and treat MB2 canal is a reason for endodontic failure in maxillary molars. Endodontically retreated teeth were found to contain more undetected MB2 canals than first-time treated teeth, suggesting that failure to treat existing MB2 canals leads to a poorer prognosis [2]. John J. Stropko 1999 studied the incidence of MB2 in the MB root of maxillary molars. There was a frequency of MB2 canals 20.0% in the maxillary third molars (U3M). [1].

In the present case report a troughing process was utilized as MB2 orifice was hidden under the thin shelves of the dentin. In middle-aged or older patients, the MB2 is typically located under a layer of dentin that sits on the pulp floor. This layer is called the "dentin shelf." [3] It was essential to locate most MB2canals, and this can be accomplished either with burs or ultrasonic instruments. With the advent of newer sets of ultrasonic, the troughing process has become faster and cleaner. In the presented case report specific Mueller burs were used followed by the ultrasonic Start X tip # 2, an MB2canal scouter for locating the orifice of hidden MB2 canal.

The MB2 orifice were usually found mesial to an imaginary line between the MB1 and palatal orifices and about 2 to 3 mm palatal to the MB 1 orifice. This imaginary line is more appropriately described as an arc with an apogee toward the mesial, following the contours of the mesial surface of the root. In the presented case report the MB2 orifice was located mesial to an imaginary line between the MB I and palatal orifices, and about 2 mm palatal to the MB1orifice.

The MB2 canal can be very challenging to negotiate even for an experienced endodontist. The MB2 canal usually has a remarkable mesial incline just apical to its orifice in the coronal 1 to 3 mm. When the instrumentation is done for MB2, the tip of the file tends to catch against the mesial wall of the canal, preventing its apical progress. Since the MB2 canal is smaller and usually more calcified than MBI, the problem is accentuated [1]. To facilitate its location and instrumentation, the access has to be rhomboidal in shape to allow the necessary mesially directed shaping in the presented case since the MB2 was hidden and finer as compared to MB1, proper care has been taken to negotiate it with fine 10# K file.

CONCLUSION

The maxillary third molar has one of the most complex root and canal anatomy. It is important that the clinician should have a strong conviction for the presence of an additional MB2 canal in 100% cases until it is proven otherwise.

REFERENCES

1. Stropko JJ. Canal morphology of maxillary molars: clinical observations of canal configurations. J Endod. 1999; 25:446-450.
2. Westesson PL, Carlsson LE. Anatomy of mandibular third molars. A comparison between radiographic appearance and clinical observations. Oral Surg Oral Med Oral Pathol. 1980; 49:90- 94.
3. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol. 1984; 58:589-599.

Evaluation of Bupivacaine in Oral and Maxillofacial Surgery: A Review

Dr. Sheeraz Badal [1], Dr. Paras Doshi [2], Dr. Govind Changule [3], Dr. Venkatesh Hange [4], Dr. Rajashree Jadhav [5], Dr. Laxmi Yogi [6]
[1]Professor & HOD, [2]PG Student, [3]Reader, [4] Lecturer, [5,6]PG Student
Dept. of Oral and Maxillofacial Surgery, MIDSR Dental College, Latur.

Abstract:
A review of significant current literature concerning bupivacaine hydrochloride (Marcaine) is presented with particular emphasis on clinical use in oral surgery. The major advantages compared with other presently used local anaesthetics are an increased duration of action and a favourable potency-to-toxicity ratio. Bupivacaine HCL (1-butyl-2', 6' pipecoloxylidide hydrochloride)* is a long-acting amide local anaesthetic (Fig. 1). First synthesised in 1957 by Ekernstam at A. B. Bafors Laboratories in Molndel, Sweden, this drug has undergone trials and received varying degrees of acceptance. Bupivacaine is a potent local anaesthetic with unique characteristics in the amide group of local anaesthetics. Local anaesthetics are used in regional anaesthesia, epidural anaesthesia, spinal anaesthesia, and local infiltration. Local anaesthetics generally block the generation of the action potential in nerve cells by increasing the threshold for electrical excitation. This activity reviews the mechanism of action, adverse event profile, toxicity, dosing, pharmacodynamics, and monitoring of bupivacaine.

Aim:

Outline the indications for the use of bupivacaine.
Review the mechanism of action of bupivacaine.
Explain the contraindications to using bupivacaine.
Summarise interprofessional team strategies for improving care coordination and communication to advance pain control and improve outcomes when using bupivacaine.

Corresponding Author: Dr. Paras Doshi, PG Student, Dept. of Oral and Maxillofacial Surgery, MIDSR Dental College, Latur. Email id.: parasdoshi9999@gmail.com

INDICATIONS

Bupivacaine is a potent local anaesthetic with unique characteristics in the amide group of local anaesthetics, first discovered in 1957. Local anaesthetics are used in regional anaesthesia, epidural anaesthesia, spinal anaesthesia, and local infiltration. Local anaesthetics generally block the generation of an action potential in nerve cells by increasing the threshold for electrical excitation. The progression of anaesthesia is dependent on factors such as the diameter, degree of myelination, and conduction velocity of nerve fibres. In clinical practise, the order of loss of nerve function is as follows [1] [2]:

Pain
Temperature
Touch
Proprioception

Skeletal muscle tone

Mechanism of Action

All local anaesthetics contain three structural components: an aromatic ring, a connecting group that is either an ester (procaine) or an amide (bupivacaine), and an ionizable amine group. In addition, all LAs have two chemical properties that determine their activity:

Lipid solubility

Ionisation constant (pKa)

Lipid solubility determines the potency, duration of action, and plasma-protein binding of local anaesthetics. Local anaesthetics enter nerve fibres as a neutral-free base. Ionised forms and the cationic form block conduction by their interaction on the inner surface of the Na+ channel. Moreover, LAs with a lower pKa have a more rapid onset of action, meaning more of it exists in an uncharged form, which renders faster diffusion to the cytoplasmic side of the Na+ channel. Na+ channels are membrane proteins that propagate action potentials in axons, dendrites, and muscle tissue. They initiate and maintain membrane potential in specialised heart and brain cells. Depending on the tissue Na+ level, channels contain one larger alpha subunit and one or two smaller beta subunits. The alpha subunit, the site of ion conduction, and local anaesthetic binding have four similar domains, each with six alpha-helical membrane-spanning segments. The external surface of the alpha-subunit is heavily glycosylated, which allows the channel to orient properly within the cytoplasmic membrane. In contrast to local anaesthetics, scorpion toxins and tetrodotoxin have binding sites on the extracellular surface of the Na+ channel.

Conduction of nerve impulses occurs through the generation of an action potential along an axon; local anaesthesia results when LAs bind the Na+ channel and inhibit the Na+ permeability necessary for the action potential. Local anaesthetics selectively inhibit the open form of voltage-gated Na+ channels. Na+ channel blockade results in the decrease or elimination of conduction in vascular smooth muscle, leading to relaxation. In the heart, this leads to decreased pacemaker activity and prolongation of the refractory period. This action is unique to bupivacaine due to its decreased rate of dissociation from blocked sodium channels, which leads to a prolongation of the maximal rate of depolarization (Vmax) and the potential for ventricular arrhythmias. Also, LAs produce dose-dependent myocardial depression and interference with Ca2+ signalling within the cardiac muscle because they also bind and inhibit cardiac voltage-gated Ca2+ and K+ channels. Local anaesthetics also bind beta-adrenergic receptors and inhibit epinephrine-stimulated cAMP formation, which can explain the refractoriness of bupivacaine CV toxicity to standard resuscitation guidelines. In the central nervous system (CNS), local anaesthetics may cause increased excitability, followed by depression. Neuronal tissues have different susceptibilities to local anaesthetics. Depolarizing currents in nerves move along nodes of Ranvier, and 2 to 3 nodes must be blocked to impair neuronal conduction completely. Smaller fibres have smaller internodal distances and, therefore, get blocked by local anaesthetics more quickly. [3]

Administration

Bupivacaine is offered in three different concentrations: 0.25%, 0.5%, and 0.75%.

Administration is by local infiltration (post-surgical analgesia), peripheral nerve blocks (dental or other minor surgical procedures, orthopaedic surgery), spinal anaesthesia (injected into the CSF to produce anaesthesia for orthopaedic surgery, abdominal surgery, or caesarean delivery), epidural anaesthesia or analgesia for labour pain, and a caudal block (anaesthesia and analgesia below the umbilicus, usually for paediatric surgery). [4] Adjuvants are often added to local anaesthetics for nerve blocks to prolong the anaesthetic effects compared to LA alone. Alpha-2 agonists such as clonidine or dexmedetomidine combined with LA have been shown to significantly increase the duration of anaesthesia. Additionally, dexamethasone, when mixed with the local anaesthetic for nerve blocks, has also been shown to increase the duration of anaesthesia, although the mechanism is unclear as to whether it is a direct neural effect or simply the systemic effect of the steroid anti-inflammatory processes. With its N-methyl D-aspartate receptor

antagonist effects, magnesium has also been associated with a prolonged duration of action of local anaesthetics for nerve blocks. Studies are ongoing evaluating the effects of these and other potential adjuvants on LAs to prolong effectiveness while minimising the risk of toxicity. [5]
In the last decade, it has been shown that ultrasound-guided nerve blocks are associated with a decreased risk of local anaesthetic toxicity. Presumably, visualisation of the nerve and surrounding structures decreases the likelihood of injection into a vascular structure and increases the early recognition of this occurrence, thereby lessening the possibility of reaching toxic levels of bupivacaine in the bloodstream. [6]

Use in Oral Surgery
Attempts to use the increased duration of action of bupivacaine to modify post-operative oral surgical pain have been made. Rapid onset, profound surgical anaesthesia, lack of toxic reactions, and increased duration of action have been realised. With the exception of Hellden and Associates, 28 studies have shown a significant delay in the initial request for post-operative analgesia. Laskin and Associates describe a protracted period of post-operative analgesia persisting after normal sensation has returned. Local anaesthetic agents in the perioral area are subject to a decreased duration of action due to the vascularity of the area. Nevertheless, obtundation of post-operative oral surgical pain for up to twelve hours is reported. Feldman and Norderam's" original oral surgical statistics indicated no difference in duration of action between 0.25% and 0.5% bupivacaine. More recent oral surgical studies indicate that the onset, duration, and degree of surgical anaesthesia are enhanced by increasing drug concentrations. Studies comparing bupivacaine with and without vasoconstrictors demonstrate no significant differences in duration between these groups. Prolongation of bupivacaine block in oral surgery may be achieved by combination with low molecular weight dextran-40. In one study, the mean duration of post-operative analgesia in the bupivacaine-dextran group was 36 hours compared to 12 hours for the bupivacaine-saline control. The mechanism suggested is the formation of a dextran-bupivacaine complex, which is absorbed much more slowly than bupivacaine alone.

Adverse Effects
The dose of bupivacaine depends on the procedure, the vascularity of the tissue, the area, the number of segments blocked, the depth or duration of anaesthesia needed, and the patient's physical condition. Bupivacaine may interact with ergot medications used for migraine headaches, blood thinners, antidepressants, or monoamine oxidase inhibitors. Immunologic reactions to local anaesthetics are rare. Allergic reactions to preservative-free amide-type local anaesthetics are rare and usually not reported. A true anaphylactic response appears more common with ester local anaesthetics or preservatives; epinephrine-containing local anaesthetic reactions are often misdiagnosed as allergic reactions. Patients may also react to preservatives such as methylparaben, which are included with local anaesthetics. Methemoglobinemia is typically associated with benzocaine or prilocaine; however, case reports exist implicating bupivacaine in rare instances. At low levels (1% to 3%), methemoglobinemia can be asymptomatic, but higher concentrations (10% to 40%) may accompany cyanosis, cutaneous discoloration (grey), tachypnea, dyspnea, exercise intolerance, fatigue, dizziness, syncope, and weakness. Some more common adverse effects include nausea, vomiting, chills or shivering, headache, back pain, dizziness, sexual dysfunction, restlessness, anxiety, vertigo, tinnitus, blurry vision, and tremors, which may precede more severe adverse effects such as convulsions, myoclonic jerks, coma, and cardiovascular collapse [2].

Contraindications
Contraindications include hypersensitivity to the drug or its components, hypersensitivity to amide anesthetics, infection at the injection site, obstetric paracervical block, and obstetric anesthesia using 0.75% concentration, intravenous regional anesthesia, and intra-articular continuous infusion. Clinicians should exercise caution in patients with hypersensitivity to sulfites, liver impairment (the liver clears amides), kidney impairment, impaired

cardiac function, heart block, hypovolemia, hypotension, and elderly, debilitated, or acutely ill patients. [7]

Monitoring

Standard monitoring required during the administration of bupivacaine includes

Continuous EKG

SpO2

Blood pressure

Ask patients to report any numbness around the lips or mouth, a metallic taste, ringing in their ears, tremors, or ominous feelings. If the patient reports any of these symptoms, the administration of bupivacaine must stop immediately, and treatment as per guidelines must follow. [2]

Toxicity

Most local anaesthetics produce similar signs and symptoms, but the ratio of neurotoxicity to cardiotoxicity may differ, with bupivacaine being the most cardiotoxic. The incidence of toxicity is rare: 1 to 1000 to 1 to 10000. Be concerned for local anaesthetic toxicity (LAST) with abnormal cardiovascular or neurological signs and symptoms. The site of administration of local anaesthetics also influences the risk of toxicity. Unintended direct intravenous injection or rapid vascular uptake of the drug is the most common reason for bupivacaine toxicity, which has an upper limit of 2.5 to 3.5 mg/kg. Depending on the vascularity of the injection site and the technique, toxicity of the medication can occur if administered at the upper limit of the dosing recommendations. Signs and symptoms of toxicity may occur rapidly or be delayed. Rarely, patients exhibit toxicity to bupivacaine at doses much lower than the suggested upper limits of dosing. This toxicity appears to be due to a rare condition related to l-carnitine deficiency. Patients affected may exhibit cardiac toxicity at doses as low as 1.1 mg/kg of bupivacaine injected cutaneously. Case reports exist describing these cases of low-dose toxicity in patients later discovered to be deficient in l-carnitine. A rat study demonstrated this model and found that the administration of supplemental l-carnitine could reverse this effect. [8]

Most-to-least toxic sites

Intravenous>Intercostal>Caudal>Epidural>Interfascial plane blocks of the abdominal wall (TAP)>Psoas compartment blocks>Sciatic blocks>Cervical plexus block>Brachial plexus block

Pathophysiology

At therapeutic levels, local anaesthetics block voltage-gated Na-channels at the alpha subunit inside the channel, preventing Na+ influx, depolarization, and action potential generation. They affect cardiac Na+ channels and neurons in the brain at toxic levels, blocking K+, Ca2+, and NMDA receptors. Local anaesthetics also interfere with cellular processes, including oxidative phosphorylation, free fatty acid utilisation, and cAMP production. Toxic levels of local anaesthetics in the heart lead to conduction irregularities, impaired cardiac contractility, and the loss of vascular tone secondary to extreme vasodilation.

Treatment

Treatment of bupivacaine toxicity has long been challenging due to its profound neurologic and cardiac toxicity. Previously, treatment had been supportive, with standard cardiopulmonary resuscitation, airway management, and seizure control with quick-acting GABA agonists such as midazolam. Because of the long duration of action of bupivacaine, toxicity was especially problematic. In centres where cardiopulmonary bypass was readily available, it was used to support the toxic patient until the drug was adequately metabolised and cleared, which may take hours. In the early 2000s, landmark research by Guy Weinberg revealed that lipid emulsion, such as the type that serves as the carrier for total parenteral nutrition formulations, was effective in rescuing laboratory animals from bupivacaine toxicity. The profound results in animals (mice and dogs) led to several case reports where lipid emulsion was used as a last resort in human patients with profound cardiovascular collapse following nerve blocks with long-acting local anaesthetics such as bupivacaine and ropivacaine. Over the following 15 years, the treatment with lipid emulsion became widely accepted as effective, was

adopted by the American Society of Regional Anaesthesia as the standard for treating local anaesthetic systemic toxicity (LAST), and has been adopted into their treatment algorithm. Once only used as a last-resort treatment, it is now widely used as a first-line treatment for these patients. Facilities that administer local anaesthetics should have lipid emulsions readily available for emergencies. Interestingly, high-dose epinephrine has shown associations with decreased effectiveness of lipid emulsions in the treatment of LAST. This evidence further emphasises the importance of early treatment with lipid emulsion when LAST is suspected. Detailed treatment algorithms are available through the American Society of Regional Anaesthesia's website. [9] The current dosing recommendations for 20% lipid emulsion are as follows:

For a patient greater than 70 kg, bolus 100 mL of lipid emulsion 20% rapidly over 2 to 3 minutes and then infuse 200 to 250 mL over the next 15 to 20 minutes. Redosing may be necessary up to a maximum dose of 12 mL/kg.

For a patient of less than 70 kg, bolus 1.5 mL/kg lipid emulsion 20% rapidly over 2 to 3 minutes, followed by an infusion of 0.25 mL/kg/min for ideal body weight to an upper limit of 12 mL/kg.

A cardiopulmonary bypass should also still be considered early in cases where other treatments are ineffective.

Enhancing Healthcare Team Outcomes

Bupivacaine is administered to patients by many healthcare professionals, including the surgeon, anesthesiologist, pain specialist, emergency department physician, and nurse practitioner. However, all interprofessional healthcare team members involved in administering and dispensing the drug must know its potential side effects and toxicity. Resuscitative equipment must be in the room at the time of the injection, and surgical nurses must be familiar with the proper use of this equipment in an emergency. The most common reason for a complication is an injection of the drug into the artery or vein, which can result in adverse cardiac and CNS effects. [10] [11]

Pharmacists can be involved in preparing the agents and verifying proper dosing and administration, working with the anesthesiologist or nurse anaesthetist. They can also assist in cases of toxicity with the drugs needed to address toxic states. Bupivacaine use requires an interprofessional team approach, including physicians, specialists, specialty-trained nurses, and pharmacists, all collaborating across disciplines to achieve optimal patient results. [Level 5]

REFERENCES

1. Shah J, Votta-Velis EG, and Borgeat A. New local anaesthetics Best Practise Res Clin Anaesthesiol 2018 Jun; 32(2):179-185. [PubMed: 30322458]
2. Wolfe RC, Spillars A. Local Anaesthetic Systemic Toxicity: Reviewing Updates From the American Society of Regional Anaesthesia and Pain Medicine Practise Advisory J Perianesth Nurs. 2018 Dec; 33(6):1000–1055. [PubMed: 30449428]
3. Li J, Duan R, Zhang Y, Zhao X, Cheng Y, Chen Y, Yuan J, Li H, Zhang J, Chu L, Xia D, Zhao S. Beta-adrenergic activation induces cardiac collapse by aggravating cardiomyocyte contractile dysfunction in bupivacaine intoxication. PLoS One. 2018; 13(10):e0203602. [PMC free article: PMC6166930] [PubMed: 30273351]
4. Iskander A., Gan T.J. Novel analgesics in ambulatory surgical patients Curr Opin Anaesthesiol. 2018 Dec; 31(6):685-692. [PubMed: 30346316]
5. Prabhakar A, Lambert T, Kaye RJ, Gaignard SM, Ragusa J, Wheat S, Moll V, Cornett EM, Urman RD, Kaye AD Adjuvants in clinical regional anaesthesia practise: a comprehensive review Best Practise Res Clin Anaesthesiol 2019 Dec;33(4):415-423. [PubMed: 31791560]
6. Barrington MJ, Uda Y. Did ultrasound fulfil the promise of safety in regional anaesthesia? Curr Opin Anaesthesiol. 2018 Oct; 31(5):649–655. [PubMed: 30004951]
7. Petrikas AZh, Ol'khovskaia EB, Medvedev DV, Diubalo MV [Disputable issues in Malamed's "Handbook of Local Anaesthesia" (2004)] Stomatologiia (Mosk). 2013; 92(2):71–6. [PubMed: 23715461]
8. Wong GK, Pehora C, Crawford MW. L-carnitine reduces susceptibility to bupivacaine-induced

cardiotoxicity: an experimental study in rats. Can J Anaesth. 2017 Mar;64(3):270–279 [PubMed: 28032304]
9. Neal JM, Woodward CM, Harrison TK The American Society of Regional Anaesthesia and Pain Medicine Checklist for Managing Local Anaesthetic Systemic Toxicity: 2017 Version Reg Anesth Pain Med. 2018 Feb; 43(2):150–153. [PubMed: 29356775]
10. Teunkens A, Vermeulen K, Peters M, Fieuws S, Van de Velde M, Rex S. Bupivacaine infiltration in children for postoperative analgesia after tonsillectomy: a randomised controlled trial Eur J Anaesthesiol. 2019 Mar; 36(3):206-214. [PubMed: 30640245]
11. Hussain N, McCartney CJL, Neal JM, Chippor J, Banfield L, and Abdallah FW Local anaesthetic-induced myotoxicity in regional anaesthesia: a systematic review and empirical analysis Br J Anaesth. 2018 Oct; 121(4):822-841. [PubMed: 30236244]

Review Article

Is Arthrocentesis of Temporomandibular Joint with Corticosteroids Beneficial? A Systematic Review

Dr. Amol Doiphode [1], Dr. Priyanka Bhapkar [2], Dr. Sheeraz Badal [3], Dr. Apurva Deshpande [4], Dr. Dnyaneshwar Sakhare [5], Dr. Trupti Nakhate [6]
[1]Professor, [2]PG Student, [3] Professor & HOD, [4] Lecturer, [5,6]PG Student
Dept. of Oral and Maxillofacial Surgery, MIDSR Dental College, Latur.

Abstract:

Background: Temporomandibular disorders (TMDs) are musculoskeletal conditions that can inhibit the normal function of temporomandibular joints (TMJs) and affect the patient's quality of life, negatively. Arthrocentesis (AC) is a minimally invasive surgical procedure used for treating TMDs. The aim of present paper is to evaluate the advantages of administrating corticosteroid (CS) during AC by reviewing high quality released articles.

Material and Methods: Searching on Cochrane Library, Web of Science, Google Scholar, PubMed, Pro Quest, and Scopus databases were performed with focusing on proper key words. Related titles and abstracts, up to April 2023, were screened and selected based on inclusion criteria. The full text of all randomized controlled trials (RCTs) was extensively read and subjected to quality assessments.

Results: After initial search, a total of 2067 articles were included into the study. Finally, 7 studies were reliable enough in methodology and randomization to be included into the study. All of the observed studies showed improvements in jaw functions and pain relief with no statistical differences in both AC and control groups. One study reported painless maximum incisal opening in CS group than the control group.

Conclusions: Based on available RCTs, the AC of TMJ with CS seems to result in similar findings to other therapeutic drugs, with no significant differences.

Keywords: Arthrocentesis, corticosteroid, temporomandibular joints, temporomandibular joint

Corresponding Author: Dr. Priyanka Bhapkar, PG Student, Dept. of Oral and Maxillofacial Surgery, MIDSR Dental College, Latur. Email id.: piyabhapkar28@gmail.com

INTRODUCTION

Orofacial pain can be severe and includes cases of intractable pain as well as acute pain. The most frequent source of orofacial pain is dental disease. Among other sources are musculoskeletal, vascular, neurovascular, and neuropathic disorders.1 musculoskeletal sources of orofacial pain are comprised of joint disorders and muscle disorders, although joint and muscle symptoms frequently

occur simultaneously. Pain arising from joint disorders is termed 'arthralgia'.

Causes of arthralgia would include mechanical nerve compression secondary to articular disc displacement, neurogenic inflammation, secondary to intra-articular changes and synovitis, adhesions, or arthritis. Historically, the displaced disc was considered the primary cause of arthralgia, but the observations that arthroscopy and arthrocentesis of the superior joint compartment reduce or eliminate pain in patients with a permanently displaced disc, without repositioning the displaced disc, have disproved the displaced disc as the cause of arthralgia. Another possible cause for arthralgia may be mechanical trauma from repetitive extreme loading (i.e., habitual jaw-clenching, bruxism), causing transient hypoxia. The hypoxia may create oxygen-derived free radicals that activate a variety of biochemical changes, leading to arthralgia.2

The current treatment modalities focus on alleviating pain and improving function. Arthrocentesis is a minimally invasive procedure aimed at removing inflammatory and pain mediators from the joint cavity solely by the intraarticular flow of saline. In addition to arthrocentesis, corticosteroids are commonly added to further reduce pain and jaw stiffness.3 Corticosteroids modify the vascular response during the inflammatory process and inhibit enzymes and the actions of inflammatory cells. Their use in the TMJ remains controversial regarding their efficacy and unknown duration.

The aim of the current study was to test the additional effect on pain and jaw stiffness of a short-acting corticosteroid (dexamethasone) following an arthrocentesis procedure in the TMJ.

Methods

Study design:

To enhance structural reporting of the articles, the reviewing setting was in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Fig.1)

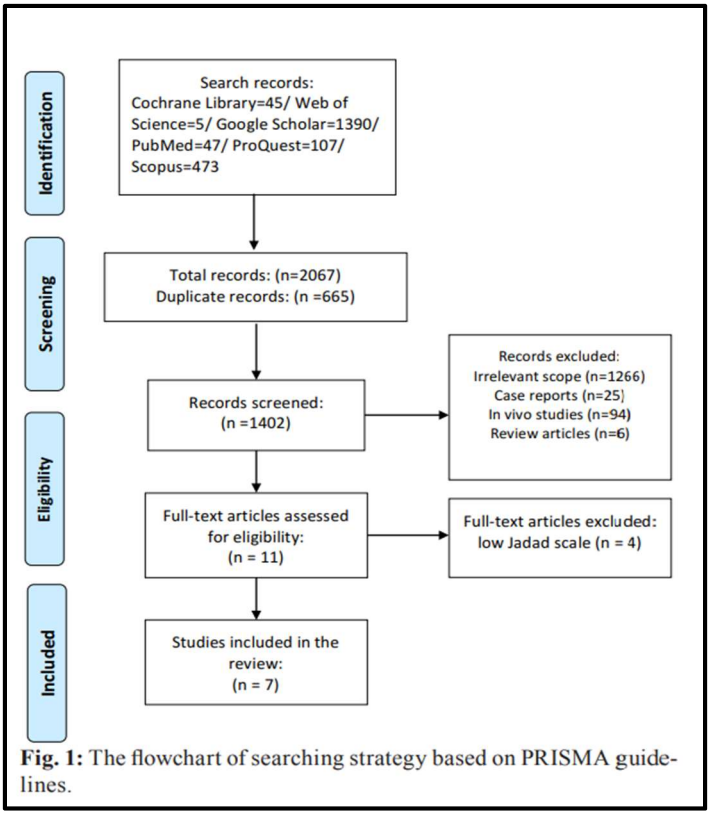


Fig. 1: The flowchart of searching strategy based on PRISMA guidelines.

Firstly, a clinical question was defined for screening the qualified clinical studies based on PICO: Patients with any kinds of TMDs (P, population) who underwent AC with CS (I, intervention), compared to other methods of TMD therapy (C, comparison) that causes the improvement of signs and symptoms (O, outcome). A data search was performed using Cochrane Library, Web of Science, Google Scholar, PubMed, ProQuest, and Scopus databases of articles, based on the defined MeSH and non-MeSH terms in simple or multiple conjunctions. The searching procedure was conducted manually up to December 2017, then Endnote software version 7 (Thomson Reuters, NY, USA) was used for final confirmation, cross matching, and avoiding any missing of data. Two independent reviewers (A.D and F.A) qualified the eligible articles to review. To select the studies, all obtained English language reports were reviewed, and titles and abstracts were screened for relevance. The review articles and references from different studies were used to identify relevant articles. In the case of disagreement between reviewers, a discussion was undertaken until mutual agreement was reached. Reviewers' agreement was tested with the

Cohen κ test by use of MedCalc software (MedCalc Software, Ostend, Belgium) (kappa score = 0.89).

The studies were subjected to Jadad Score Calculation for Critical Appraisal and lowering the risk of biases. They were classified as follow: 1-2 low quality, 3 moderate, and 4-5 high quality. The full text of relevant abstracts was obtained and selected using the following inclusion and exclusion criteria.

Inclusion criteria:

- English language randomized clinical trials (RCTs) and prospective studies that investigated the effect of TMJ AC with CS
- Clinical research on at least 5 patients
- Maintaining the standard indications and guidelines of AC procedure
- Performed at least one standard test for evaluating clinical effects or side effects of CS

Exclusion criteria:

- Case reports
- Animal studies
- Studies with missing data
- Repeatedly published studies; the last version was included
- Studies in languages other than English
- Studies with Jadad score of < 3 (for eliminating the risk of biases)

The initial literature search yielded on 2067 articles in which 1402 articles remained after removing duplicates. After the first screening based on the title and abstract, 11 studies were found eligible which reached to 7 studies after excluding high risk article. Full-texts of the all articles were reachable for initiating reviewing process.

Data Extraction:

The following data were collected for each study: author, year, study design, participants (age, gender), method of TMD diagnosis, administered CS and dosage, the monitoring tests before and after AC, clinically significant outcomes. After gathering information, the possibility of preparing a meta-analysis was judged by an independent statistician and epidemiologist. As the collected data were vastly heterogeneous (like different corticosteroid drugs with different dosages, different diagnosis of TMD, different clinical test on the patients, and etc.) no meta-analysis were prepared.

DISCUSSION

Temporomandibular disorders (TMDs) are musculoskeletal conditions that can inhibit the normal Function of temporomandibular joints (TMJs) and affect the patient's quality of life, negatively. The treatment of the temporomandibular joint (TMJ) is still controversial.1 The TMD is a wide terminology in which conditions disturbing the masticatory function are included. The internal derangement is described as displacement of the articular disc in association with clicking and popping sounds.4 The most common cause is trauma, which results in an immediate displacement of the disc or chronic dysfunction, which results in degenerative changes in the articular surfaces, increased friction, and gradual disc displacement. It has always been an operative challenge. The AC has been shown to be an effective method in the treatment of patients showing clinical findings in the diagnosis of internal TMJ derangement.5 TMJ arthrocentesis represents a form of minimally invasive surgical treatment in patients suffering from internal derangement of the TMJ, especially closed lock.6 It consists of washing the joint with the possibility of depositing a drug or other therapeutic substance. Arthrocentesis of the temporomandibular joint is a method at the boundary between conservative and surgical therapy. It is usually performed on an out-patient basis under local anaesthesia.7 It is used both in cases of acute block caused by displacement of the articular disc and also to treat degenerative inflammatory diseases of the joints.8

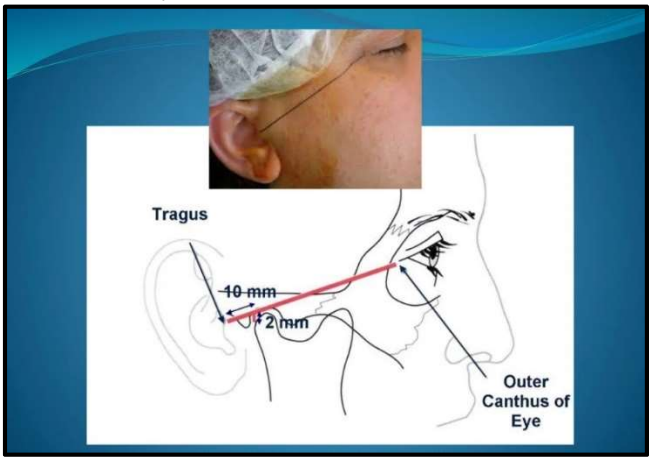


Fig .2 Anatomical Landmarks for Needle Entry

The main objective of arthrocentesis is to wash out inflammatory mediators, release the Disc, break adhesions, eliminate pain and improve joint mobility. Resolution of symptoms is due to the removal of chemical inflammatory mediators and changes in intra-articular pressure. It is a method with a minimum number of complications, it is simple and not demanding in terms of instruments, and it can be performed repeatedly. For this reason, it has become widespread and very popular in the treatment of internal disorders of the temporomandibular joint.9

Some researches were carried out regarding use of corticosteroids for AC. numerous clinical studies regarding this technique have been published. The aim of present paper is to evaluate the advantages of administrating corticosteroid (CS) during AC by reviewing high quality released articles.10, 11

As per the systematic review by Amin Davoudi, Hossein Khaki et al, regarding whether arthrocentesis of temporomandibular joint with corticosteroids is beneficial? They concluded according to the available RCTs on the role of CS during AC of TMJ, no significant result was found among CS groups and other groups (either control or other drugs). Only One Study reported painless maximum incisal opening in CS group than the control group. Although, reliable documents on effectiveness Of CSs during AC of TMJ are not vast enough for making more determinant conclusion, it seems that CS do not present better properties than other therapeutic Drugs during AC.12

J.J.R. Huddleston Slater, L.M. Vos et al, carried out Randomized Trial to compare the Effectiveness of Dexamethasone in TMJ Arthrocentesis. Twenty-eight participants with TMJ arthralgia were randomly Assigned to two groups of a parallel double-blind RCT. In both groups, an arthrocentesis procedure was carried out. In one group, the procedure was followed by the administration of a single-dose Intra-articular dexamethasone. In the other group, Saline was administered as a control. Follow-up Visits were scheduled after 1, 3, and 24 weeks. During each visit, TMJ pain (on a 100-mm VAS) And jaw stiffness (mouth opening in mm) was scored. In the statistical analysis, generalized estimating equation (GEE) models showed no differences between the two study groups, although pain and jaw stiffness were both reduced over 24 Weeks. They found, intra-articular dexamethasone following arthrocentesis did not improve the Procedure's effect in patients presenting with TMJ Arthralgia.13

Dexamethasone modifies the vascular response during the inflammatory process and inhibits both destructive enzymes and the actions of inflammatory cells.14 It has Been suggested that this decrease in inflammatory potency of the Synovial fluid would result in greater pain reduction, but this Study showed that the effect of dexamethasone contributed in a Minor way to that effect, if at all because of small sample sizes, this study was also unable to Identify any side-effects of dexamethasone.15 One uncertainty is the unknown working time of dexamethasone in the TMJ. Its Half-life of 36 to 72 hrs makes it unlikely that long-term effects can be expected. Their analyses also did not suggest a long-term Effect. However, these half-life effects do not count for all corticosteroids. Kenacort, for example, has a longer half-life and May have a longer lasting effect as compared with dexamethasone. Kenacort, however, is opaque white and is more difficult to test in a double-blind fashion. They concluded, intra-articular dexamethasone following an Arthrocentesis procedure did not improve the effect of the Arthrocentesis in patients presenting with TMJ arthralgia.16

Reza Tabrizi, DMD, Tuba Karagah et al, studied Outcomes of Arthrocentesis for The Treatment of Internal Derangement Pain, with or without use of Corticosteroids. Their study of two groups with Comparison of age, sex, and skeletal relationship did not Show any significant differences between the 2 groups. Results did not demonstrate any difference for click between the 2 groups. Comparison Of pain severity in T0, T1, and T2 between the 2 groups did not show any significant differences ($P < 0.05$). The repeat measure test revealed a significant change in T0, T1, and T2 for both groups ($P < 0.001$). MMO significantly changed between T0 and T1 and T0 and T6 in the 2 groups without any significant differences between them.17

They concluded that The AC is an effective procedure for a short-term reduction of pain in temporomandibular disorder cases. It seems that AC

using Ringer solution with or without corticosteroids may have the same effect on pain relief.

CONCLUSION

The AC is an effective procedure for a short-term reduction of pain in TMD cases. Although, various documents on effectiveness of CSs during AC of TMJ are present but they are not vast enough for making more determinant conclusion, it seems that CSs do not present better properties than other therapeutic drugs during AC and AC using Ringer solution with or without corticosteroids may have the same effect on pain relief.

REFERENCES

1. Davoudi A, Khaki H, Mohammadi I, et al. Is arthrocentesis of temporomandibular joint with corticosteroids beneficial? A systematic review. Med Oral Patol Oral Cir Bucal. 2018; 23(3):e367-e375.
2. Bouchard C, Goulet JP, El-Ouazzani M, Fournier-Turgeon A. Temporomandibular Lavage versus Nonsurgical Treatments for Temporomandibular Disorders: A Systematic Review and MetaAnalysis. J Oral Maxillofac Surg. 2017;75:1352-1362
3. Li C, Zhang Y, Lv J, Shi Z. Inferior or double joint spaces injection versus superior joint space injection for temporomandibular disorders: a systematic review and meta-analysis. J Oral Maxillofac Surg. 2012; 70:37-44.
4. Tjakkes GH, Reinders JJ, Tenvergert EM, Stegenga B. TMD pain: the effect on health-related quality of life and the influence of pain duration. Health Qual Life Outcomes. 2010; 8:46.
5. Verma SK, Maheshwari S, Chaudhari PK. Etiological factors of temporomandibular joint disorders. Natl J Maxillofac Surg.2012; 3:238-9.
6. Stechman-Neto J, Porporatti AL, Porto de Toledo I, Costa YM, Conti PC, De Luca Canto G, et al. Effect of temporomandibular disorder therapy on otologic signs and symptoms: a systematic review. J Oral Rehabil. 2016; 43:468-79.
7. Conti PC, de Alencar EN, da Mota Correa AS, Lauris JR, Porporatti AL, Costa YM. Behavioural changes and occlusal splints are effective in the management of masticatory myofascial pain: a shortterm evaluation. J Oral Rehabil. 2012; 39:754-60.
8. Alpaslan C, Kahraman S, Guner B, Cula S. Does the use of soft or hard splints affect the short-term outcome of temporomandibular joint arthrocentesis? Int J Oral Maxillofac Surg. 2008; 37:424-7.
9. Tatli U, Benlidayi ME, Ekren O, Salimov F. Comparison of the effectiveness of three different treatment methods for temporomandibular joint disc displacement without reduction. Int J Oral Maxillofac Surg. 2017; 46:603-609.
10. Monje-Gil F, Nitzan D, Gonzalez-Garcia R. Temporomandibular joint arthrocentesis. Review of the literature. Med Oral Patol Oral Cir Bucal. 2012; 17:e575-81.
11. Arthrocentesis of the temporomandibular joint: A review Peter Tvrdy, Petr Heinz, Richard Pink.
12. Is arthrocentesis of temporomandibular joint with corticosteroids beneficial? A systematic review Amin Davoudi, Hossein Khaki, Iman Mohammadi, Mehran Daneshmand, Alireza Tamizifar, Meysam Bigdelou, Farzin Ansaripoor.
13. Randomized Trial on the Effectiveness of Dexamethasone in TMJ Arthrocentesis J.J.R. Huddleston Slater, L.M. Vos, L.P.P. Stro, and B. Stegenga
14. Emshoff R, Puffer P, Strobl H, Gassner R. Effect of temporomandibular joint arthrocentesis on synovial fluid mediator level of tumor necrosis factor-alpha: implications for treatment outcome. Int J Oral Maxillofac Surg. 2000; 29:176-82.
15. Gulen H, Ataoglu H, Haliloglu S, Isik K. Proinflammatory cytokines in temporomandibular joint synovial fluid before and after arthrocentesis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod.2009; 107:e1-4.
16. Outcomes of Arthrocentesis for the Treatment of Internal Derangement Pain: With or Without Corticosteroids? Reza Tabrizi, DMD, Tuba Karagah, DMD,Hamidreza Arabion, DMD, Mohammad Reza Soleimanpour, DMD, Mehrnaz Soleimanpour

Review Article

Orthodontic Management of Creniofacial Disorders: A Review Article

Dr. Pravinkumar Marure [1], Dr. Nikhil Mukhedkar [2], Dr. Suresh Kangne [3], Dr. Ankita Jaybhaye [4], Dr. Siddhant Jadhav [5]
[1]Professor, [2]PG Student, [3]Professor & HOD, [4, 5] PG Student
Dept. of Orthodontics, MIDSR Dental College, Latur.

Abstract:
A craniofacial malformation is a defect in embryonic development that causes significant impairments in the normal anatomy of the skull, jaws, and associated soft tissues. Because the problems of these patients frequently differ significantly from those of normal patients, geneticists, surgeons, paediatricians, neurosurgeons, ENTs, orthodontists, ophthalmologists, speech therapists, and many others who will care for them should all have a very specific expertise in the field. As one of several specialists on the craniofacial team, the orthodontist plays a critical role in the stabilisation and optimisation of craniofacial abnormalities from birth to skeletal growth maturation.
In this article, the most encountered craniofacial anomalies related to the field of orthodontics will be discussed in groups with more focus will be given to the role of the orthodontists in the management of these anomalies.
Keywords: Craniofacial disorders, Orthodontic management.

Corresponding Author: Dr. Nikhil Mukhedkar, PG Student, Dept. of Orthodontics, MIDSR Dental College, Latur. Email id.: mukhedkarnikhil99@gmail.com

INTRODUCTION

A craniofacial malformation is a defect in embryonic development that causes significant impairments in the normal anatomy of the skull, jaws, and associated soft tissues. Most birth abnormalities fall into the "craniofacial" category. Children with craniofacial deformities necessitate highly precise and one-of-a-kind medical care. Because the problems of these patients frequently differ significantly from those of normal patients, geneticists, surgeons, paediatricians, neurosurgeons, ENTs, orthodontists, ophthalmologists, speech therapists, and many others who will care for them should all have a very specific expertise in the field[1]

As one of several specialists on the craniofacial team, the orthodontist plays a critical role in the stabilisation and optimisation of craniofacial abnormalities from birth to skeletal growth maturation. To support skeletal, dental, and soft tissue components, systematic techniques of orthodontic therapy protocols must be followed, depending on the the aberration. This was proven to considerably increase the psychological state of patients who were previously suffering from due to the prevalence of facial deformities. Some of the most important craniofacial anomalies connected to orthodontics will be covered briefly in groups in this article. The involvement of orthodontists in the management of these aberrations will be emphasised further.[2]

In this article, only the four main craniofacial anomalies groups will be presented in terms of facial and occlusal features accompanied with and the role of the orthodontist in the management as a member of the craniofacial medical team. Such management principles could be effective for other defects, but the exact pathology of the affected facial skeleton is

required to pick between the appropriate and valid orthodontic treatment choices.

❖ **Recommended Nomenclature[3]**

Nomenclature (suggested definitions)

A. Malformation—a primary structural defect that results from a localized error of morphogenesis, e.g., cleft lip

B. Deformation—an alteration in shape and/or structure of a previously normally formed part, e.g., torticollis

C. Anomalad—a malformation together with its subsequently derived structural changes, e.g., Robin anomalad

D. Malformation syndrome—a recognized pattern of malformation presumably having the same etiology and currently not interpreted as the consequence of a single localized error in morphogenesis, e'g Down syndrome

E. Association—a recognized pattern of malformations which currently is not considered to constitute a syndrome or an anomalad; as knowledge advances, an association may be reclassified as a syndrome or as an anomalad. e.g., hemihypcrtrophy with Wilms tumor

A wide variety of craniofacial anomalies are reported in the literature with extensive lists of facial dysmorphology types. The most common facial malformations are cleft lip and cleft palate. Less frequent are the syndromes of the I and II branchial arches and the forms more accurately called "craniofacial", that primarily involve the midface and the skull; craniofacial synostosis

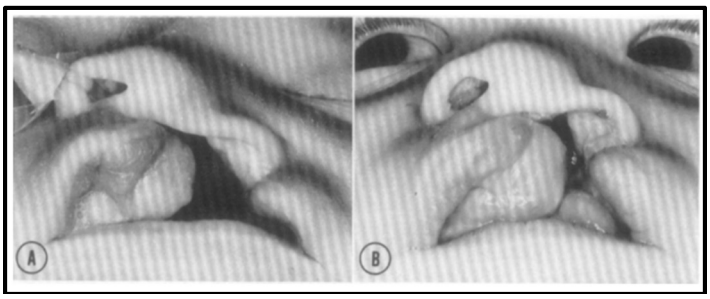
Classification of Craniofacial Anomalies[4]

1. Orofacial clefting syndromes
   a) Cleft lip and palate
   b) Pierre-Robin syndrome
2. Craniosynostosis
   a) Muenke Syndrome
   b) Crouzon Syndrome
   c) Apert Syndrome
   d) Crouzondermoskeletal syndrome
   e) Pfeiffer Syndrome
   f) Carpenter Syndrome
   g) Jackson-Weiss syndrome
   h) Saethre-Chotzen Syndrome
3. Branchial arch disorders
   a) Hemifacial microsomia
   b) Treacher Collins syndrome
   c) Goldenhar Syndrome
   d) Di George's syndrome
   e) Nager Syndrome
   f) Miller Syndrome
   g) Oro-facial-digital syndrome
4. Syndromes affecting bone/cartilage
   a) Achondroplasia
   b) Cleido-cranial dysplasia
5. Others
   a) Binder's syndromes (maxilla-nasal dysplasia)

1. Orofacial clefting syndromes

A. Cleft lip and palate

Facial clefts can manifest as a single cleft palate (CP), a single cleft lip (CL), or a combination of both (CLP). These symptoms can be unilateral, bilateral, solitary, or part of a more complex disease. Around 400 syndromes have been reported, with clefting being one of the symptoms.



(Fig no. 1 Unilateral total cleft)

Examples include; Van der Woude syndrome, Stickler syndrome, Treacher Collins syndrome and Pierre-Robin syndrome. The general orthodontic treatment of patients with CLP is divided into four phases.[1]

a) **Presurgical infant orthopaedics.**
b) **Treatment in the deciduous dentition.**
c) **Treatment in the mixed dentition.**
d) **Treatment in the permanent dentition.**

a) Presurgical infant orthopaedics

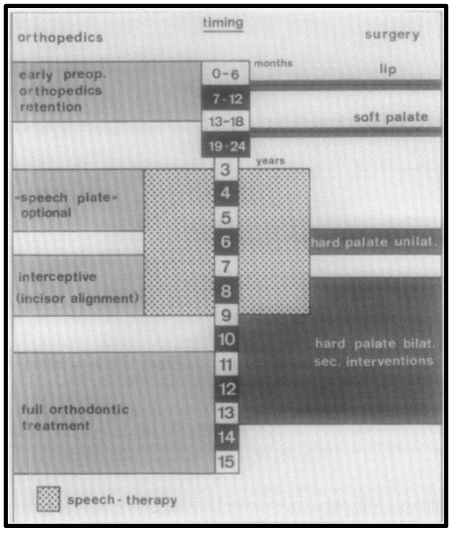
Presurgical infant orthopaedics with the NAM method is extremely beneficial for patients with bilateral CLP. However, such a protocol is not required for persons who have unilateral CLP. At this point, parents require supporting psychological therapy.5

b) Treatment in the deciduous dentition

At this stage, only cross bite cases with mandibular shift should be targeted with basic techniques such as grinding of the premature contacts that caused the shift. Otherwise, waiting till the mixed dentition period is best.6

c) Orthopaedics and Orthodontics in the mixed dentition

At this stage, the primary goal of the patients' treatment is to prepare them for alveolar bone transplantation. Palatal arch expansion, preferably using a Hyrax expander, is the most successful procedure, combined with simple orthodontic mechanics, for aligning emerging permanent teeth, not only for functional reasons, but also for cosmetic and psychological ones for both the patient and the parents.7



(Fig. 2. Timing of procedures. Active treatment is limited to definite periods as necessity demands, in order not to overstress patients. Surgery is delayed until functional requirements impose anatomic continuity. Speech therapy entails, from 3 to 5 years of age, coaching of parents and child; from 5 years of age and later, actual treatment according to the individual situation, either on an outpatient basis or in boarding school emphasizing speech therapy.)

d) Orthodontic treatment in the permanent dentition

At this stage, orthodontic therapy may be final or used to prepare for future orthognathic surgery. Orthognathic surgery may be beneficial for CLP individuals who have substantial skeletal discrepancies. Because of the diminished nasal support and insufficient thickness of the upper lip, a patient with CLP is always more in need of extra maxillary support via maxillary advancement surgery with Le Fort I osteotomy. 8 Some individuals may have substantial palatal and labial scarring, increasing the likelihood of post-orthognathic surgical recurrence. Distraction osteogenesis is required in these individuals, particularly in growing children, and has been demonstrated to greatly improve cosmetic results.

B. Pierre-Robin syndrome

The Pierre Robin sequence (PRS) is a trio of micrognathia, glossoptosis, and airway obstruction that is present at birth. PRS people with related disorders have genes that are unique to the illnesses. Micrognathia was recognised as the key feature of PRS by clinical experience and a literature analysis, and it was coupled with two other required conditions: glossoptosis and upper airway obstruction.

Orthodontic management

The orthodontist on the team oversees tooth development, short maxilla arch due to palate cleft, and insufficient maxillary and mandibular jaw growth. Orthodontic therapy should be carried out in coordination with the cleft and craniofacial team, with an emphasis on the airway and feeding management plan. Adult patients with PRS may

present to treat orthodontic recurrence, improve facial aesthetics, or address sleep apnea symptoms.

2. Craniosynostosis syndromes (CFS)

Craniosynostosis, defined as the early fusion of one or more cranial sutures, is one of the most frequent congenital craniofacial deformities, occurring approximately 1 in 2000 to 2500 live births. Patients with deformed head shapes have a lack of growth perpendicular to fused sutures and compensatory growth at normal ones10. The vast majority of craniosynostosis instances are isolated or nonsyndromic, while 9% to 40% of patients have a syndromic form, with over 130 symptoms connected with craniosynostosis.10, 11

(Fig.3. Intraoral findings in Craniosynostosis syndromes)

Patients with syndromic craniosynostosis may also have concomitant facial, trunk, and extremity abnormalities that vary in appearance, severity, and aetiology.Early detection and treatment of craniosynostosis is critical to ensure that brain growth is not hampered by low cranial volume and to minimise cranial deformation. In severe situations, patients may have elevated intracranial pressure (ICP) and functional issues (for example, trouble breathing, choking or vomiting during feeding), exorbitism, irritability, developmental delays, and even death.

Syndromes associated with craniosynostosis

A. Muenke Syndrome

Muenke syndrome is an autosomal dominant condition that affects one in every 30,000 live births. It is distinguished by unicoronal or bicoronal synostosis12. Muenke syndrome is characterised by macrocephaly, midface hypoplasia, and developmental delay. Anterior crossbite, class III molar and canine connection, and a concave profile are all characteristics of a class III skeletal pattern.13

B. Crouzon Syndrome

Crouzon syndrome is an autosomal dominant condition that affects one in every 25,000 live births.Crouzon syndrome is distinguished by the presence of bicoronal synostosis, brachycephaly, shallow orbits with ocular proptosis, hypertelorism, midface hypoplasia, and relative mandibular prognathism.Crouzon syndrome is characterised by maxillary deficit in the vertical, transverse, and sagittal dimensions, as well as an anterior open bite, posterior and anterior crossbites, and significant crowding of the maxillary arch.14,15,16 Because to severe teeth-to-arch size disparities, teeth frequently become impacted (typically canines) or erupt labially/palatally. Lip incompetence and localised gingival irritation are common in those with severe midface hypoplasia.17, 18

C. Apert Syndrome

Although the majority of Apert syndrome cases are sporadic, an autosomal dominant inheritance pattern has been seen. It affects one in every 100,000 live births.19 It presents similarly to Crouzon syndrome, but with more severe midface hypoplasia and syndactyly of the fingers and toes. Apert syndrome is distinguished by a 1- to 2-year delay in dental development, delayed tooth eruption, crowding of upper teeth, and skeletal discrepancy between the maxilla and mandible.According to Boulet and colleagues, 40% of patients with syndromic craniosynostosis have Apert syndrome. Because those with Apert syndrome have hypoplastic maxillary growth and airway constriction, resulting in mouth breathing and anterior open bites, orthodontic intervention during growth could be critical in decreasing the impact of the growing dentofacial deformity. Apert syndrome is distinguished by the presence of bulbous lateral palatal swellings that create the appearance of a

pseudocleft.19 Food retention and inflammation of adjacent tissues are prevalent in such circumstances. Patients with syndactyly are usually unable to follow basic oral hygiene procedures, resulting in poor oral hygiene, an increased risk of caries, and gingivitis.20, and 21 D. Pfeiffer Syndrome

Pfeiffer syndrome is autosomal dominant and affects one out of every 100,000 live births. Pfeiffer syndrome is classified into three subtypes: type I Pfeiffer syndrome, which presents with midface hypoplasia, brachydactyly, and variable syndactyly. The usual presentation of type II is a cloverleaf head, Pfeiffer hands/feet, and elbow ankyloses. Except for the Cloverleaf skull, type III has all of the characteristics of type II. Type III patients also have severe ocular proptosis, a very short anterior cranial base, and visceral abnormalities.22

(Fig.4. Extraoral features of Pfeiffer syndrome)

Orthopaedic and orthodontic treatment of patients with craniofacial synostosis (CFS):

Sutural growth of the cranial base and maxillary-zygomatic complex is substantially impeded in this category of craniofacial defects, and there is mostly pathological appositional growth, resulting in considerable vertical dento-alveolar growth. As a result, maxillary orthopaedic treatment may be approached differently than in normal patients. There is no evidence in the literature on the precise indications of when it is possible to extend the palate in a child with CFS. Ferraro et al. proposed that individuals with CFS avoid fast palatal growth. Schuster reported that such a surgery might be reserved for patients under the age of five, with only a 2-3 mm expansion and then checking the real enlargement with an occlusal X-ray of the palate. If the expansion appears to be solely dental, the expansion device should be withdrawn to avoid severe mobilisation and early primary tooth loss. Rapid palatal extension with surgical assistance may then be explored early.23

Any device used to encourage maxillary growth should be avoided in children with CSF because these patients have early congenital fusion of the cranial base and malar sutures. However, in circumstances where patients got distraction osteogenesis of the midface via an external device and the distraction device was withdrawn early for one reason or another, a facial mask may be effective in the retention phase.

(Fig.5. Facial morphology and occlusal changes from early childhood through surgical and orthodontic treatment to adulthood in a patient with Apert syndrome.)

Instead of improving tooth aesthetics, an important goal of orthodontic therapy in CFS patients is to prepare the patient for future surgical stages, such as the requirement for Le Fort III and rigorous external fixation, as close interaction with the surgeon is constantly required. The majority of CSF patients have significant skeletal open bites that necessitate orthognathic surgery to posteriorly impact the maxilla with a clockwise rotation. The maxillary incisors are retroclinated as a result of this surgery.24 Presurgical orthodontics should target the inclination of these teeth to be more proclined for this purpose. Crowding is usually severe enough that permanent teeth must be extracted. The need for surgical tooth uncovering is common and should be considered.

3. Syndrome Branchial arch disorders

Hemifacial microsomia (HFM), Goldenhar syndrome, and Treacher-Collins syndrome are all linked to abnormalities of the first and second branchial arches.

A. Hemifacial microsomia

HFM affects the development of the lower half of the face, most notably the ears, mouth, and mandible, but it can also affect the eye, cheek, neck, and other regions of the skull, as well as nerves and soft tissue. Asymmetric midface hypoplasia, mandibular hypoplasia, TMJ ankylosis, macrostomia, and CL and/or CP identify it. Goldenhar Syndrome, also known as Oculo-Auriculo-Vertebral syndrome, is a rare congenital disorder in which the ear, nose, soft palate, lip, and jaw do not develop normally. Other observations include a V-shaped palate, severe class II malocclusion, increased mandibular plane angle, mandibular retrognathism, and CL/CP.

Orthopaedic and orthodontic treatment of patients with 1st and 2nd branchial arch syndromes:

Because this craniofacial group's anomalies almost all share facial and occlusal traits, orthodontic treatment options for HFM patients will be described in the next section, which might be methodically handled for additional anomalies.

Orthopaedic treatment for patients with HFM:

This topic is fraught with disagreement in the literature, as it is with mandibular orthopaedic treatment for otherwise normal growing patients with defective mandibles. There is no empirical evidence that a functional appliance can influence mandibular growth, according to the American Association of Orthodontics in 2005.25

Several case reports on how HFM patients responded to functional simulation. The majority of these cases are "Pseudo-HFM," or misdiagnosed HFM individuals with severe non-congenital mandibular asymmetries, most likely as a result of very early trauma.

According to Vargervik, the genuine response of HFM patients to functional treatment is usually fairly mild and time restricted. In moderate circumstances, orthopaedic treatment can correct an asymmetry by gaining primarily dentoalveolar compensation while accepting some degree of skeletal asymmetry. Some writers recommend using asymmetrical or hybrid functional applications to maintain a less oblique occlusal plane and to engage the musculature on the afflicted side, resulting in better facial symmetry.

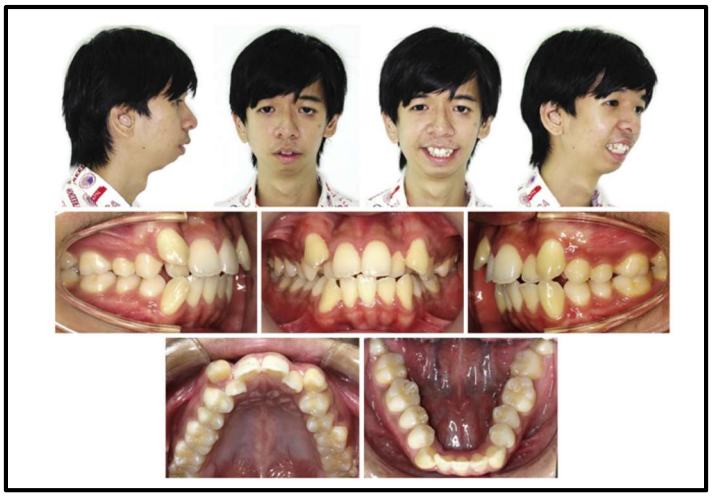
Pre- and post-surgical functional orthopaedics has also been proposed to strengthen the stability of the surgical result when costochondral grafting or pre and after distraction osteogenesis is required. However, this treatment was discovered to be incapable of long-term maintenance of postsurgical mandibular skeletal symmetry.26

Orthodontic treatment for patients with Hemifacial microsomia (HFM):

HFM patients may have maxillary crowding and constriction on the afflicted side. Given the correct shape, a quick palatal expansion could be beneficial. The midline location should be reviewed with the surgeon who will conduct the future osteotomies in order to lessen the child's burden of care and avoid round tripping of teeth. Orthodontic treatment in adults is typically used to prepare for orthognathic surgery and follows the same concepts as presurgical orthodontics in asymmetries.

B. Treacher-Collins syndrome

Treacher Collins Syndrome is distinguished by malar and mandibular abnormalities, a convex facial profile, macrostomia due to lateral clefting and CP with or without CL, and class II anterior open bite malocclusion.



(Fig.6. Extraoral and intraoral findings of Treacher-Collins syndrome)

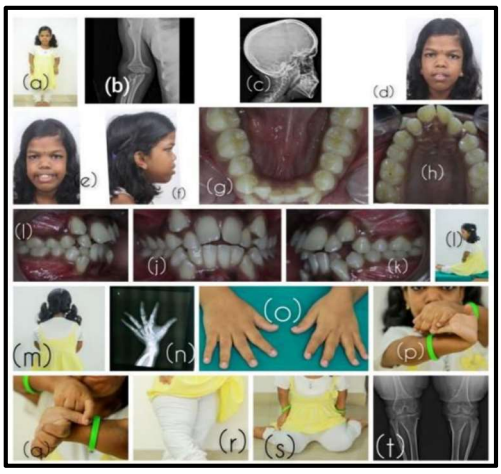
Orthodontic treatment for patients with Treacher-Collins syndrome

The surgical goals for this patient's facial and jaw bone repair were raising ramal height and mandibular body length, restoring facial harmony, and extending the posterior airway through skeletal framework expansion. Presurgical orthodontic treatment aims to eliminate three-dimensional dental compensation, which includes crowding relief, proper tooth alignment, retroclination of mandibular anterior teeth, creation of a larger overjet, coordination of arch forms, and elimination of occlusal interferences. Camouflage orthodontics, orthodontics with anticlockwise maxillomandibular advancement (MDO), and orthodontics with maxillomandibular advancement (MMA) are some of the other techniques available.27, 28

4) Syndrome Syndromes affecting bone/cartilage

a) Achondroplasia

Achondroplasia is a kind of dwarfism characterised by stunted stature and excessive limb shortening. Achondroplasia is of particular interest in dentistry due to its distinctive craniofacial traits, which include relative macrocephaly, a depressed nasal bridge, and maxillary hypoplasia. The presence of a big head, an implanted shunt, airway blockage, and difficulty controlling the head necessitates additional measures during dental management. Orthodontic treatment for patients with Achondroplasia.29



(Fig.7. a-whole body of the patient,b- rhizomelic disproportion of the limbs, c-pretreatment lateral cephalogram,d,e,f- Pretreatment extraoral, g,h,I,j,k- Pretreatment intraoral,l- lumbar lordosis, myphosis,n- handwrist radiograph,o- trident configuration,phypermobile wrist,q- hypermobile thumb,r,s- hypermobile knees,t bowing of legs).

Achondroplasia treatment includes both orthodontic and orthognathic surgical treatments. To rectify the cross-bite malocclusion and gain space, orthodontic treatment should be started as soon as possible with a palatal expansion device. Myofunctional therapy to prevent tongue thrusting should be continued throughout orthodontic treatment29. When the difference between the maxilla and mandible is not significant or the skeletal deformity is not the primary issue, the treatment decision in patients with achondroplasia may be confined to orthodontic treatment exclusively.

The literature on orthognathic surgery and achondroplasia is sparse. Surgical techniques are often determined by the degree of the facial skeletal abnormalities. The problem analysis clearly shows that numerous components of the face skeleton must be moved into new positions in order to achieve occlusion correction. Both the upper and lower midface appear to require synchronous motions in opposite directions to normalise the typical skeletal abnormality. However, when evaluating the pathophysiology, the key aberration to rectify is retrusion of the midface.

Satisfactory craniofacial function and aesthetics have been achieved in severe cases with thorough correction employing various craniofacial surgery procedures, such as frontofacial advancement and Le Fort I and vertical subsigmoid osteotomy30. A simple combination and application of common craniofacial surgery techniques in achondroplastic patients resulted in a very good outcome. However, regardless of the approach used, the main aberration is connected to the cranial-base limitation.

Following the completion of active growth, further surgery to treat the remaining bone abnormalities may be performed. The dentoalveolar component of a skeletal abnormality can be managed apart from the craniofacial component. 24 Patients suffering from achondroplastic disease can be treated in phases. Karpagam et al describe a 14-year-old female achondroplasia patient with an anterior openbite,

vertical maxillary excess, significant maxillary retrusion, and Class I molar relation with lip incompetence31. They recommended first correcting the dental component of the anterior open bite, followed by treatment of the upper midface, including the nasal complex.

b) Cleido-cranial dysplasia

Cleidocranial dysplasia (CCD), an autosomal dominant condition with a one-in-a-million frequency, is mostly caused by mutations in Runx2, a gene needed for osteoblastic development. It's distinguished by hypoplastic clavicles, a small thorax, and delayed or absent fontanel closure. Notably, its orofacial symptoms, such as midfacial hypoplasia, retained primary teeth, and impacted permanent and supernumerary teeth, substantially impair affected individuals' well-being32. Successful treatment of orofacial disorders necessitates the collaboration of dental professionals. However, because to the rarity of CCD and the intricacy of the treatment, only a few successful cases have been reported.

(fig.8. Extra and intraoral findings of Cleido-cranial dysplasia)

Individuals suffering from CCD require a thorough diagnostic work-up as well as a long-term therapy plan. The UCSF (University of California, San Francisco) therapy protocol combines the Bronx and Belfast-Hamburg techniques and is divided into five phases. It entails the precise placement of supernumerary and retained primary teeth, surgical exposure of impacted permanent teeth, orthodontic extrusion and alignment, Le Fort I advancement, and implant retained prosthesis33.

CONCLUSION

To obtain the greatest long-term aesthetic and functional results, orthodontic therapy for patients with craniofacial anomalies is more complex, requires more time and clinical resources, and should be based on exact collaboration with numerous dental, surgical, and medical professionals.

Because orthodontic management is frequently required prior to most surgical procedures involving craniofacial anomalies, management protocols should be based on a precise understanding of the exact nature of the anomalies, as certain mechanics may be provided efficiently, safely, and with acceptable durability, while other techniques may be ineffective with some complications.

REFERENCES

1. Meazzini MC, Brusati R, Bozzetti A, Mazzoleni F, Felisati G. Craniofacial anomalies: surgical-orthodontic management. In: Edizioni Martina. 2011.
2. Hickey AJ, Salter M. Prosthodontic and psychological factors in treating patients with congenital and craniofacial defects. J Prosthet Dent [Internet]. 2006; 95(5):392–6.
3. Smith, D. W.: Classification, nomenclature, and meaning of morphologic defects, J. Pediatr. 87:162, 1975.
4. Al-Tarawneh AM, Alrbata RH, Fazemi K, Hadaddin K. Orthodontic Management of Craniofacial Anomalies, a Summary of the Available Options. Int J Dent Oral Health. 2016; 2(3).
5. Hotz M, Gnoinski W. Comprehensive care of cleft lip and palate children at Zürich University: a preliminary report. Am J Orthod [Internet]. 1976; 70(5):481–504.
6. Posnick JC. Orthognathic surgery for the cleft lip and palate patient. Semin Orthod [Internet]. 1996; 2(3):205–14.
7. Brustai R, Meazzini MC. Primary columella lengthening in bilateral cleft lip and palate

patients: 10 year follow up. BAOMS meetimg Nice. 2011;
8. Posnick JC, Taylor M. Skeletal stability and relapse patterns after Le Fort I osteotomy using miniplate fixation in patients with isolated cleft palate. Plast Reconstr Surg [Internet]. 1994; 94(1):51–8; discussion 59-60.
9. Buchenau W, Urschitz MS, Sautermeister J, Bacher M, Herberts T, Arand J, et al. A randomized clinical trial of a new orthodontic appliance to improve upper airway obstruction in infants with Pierre Robin sequence. J Pediatr [Internet]. 2007; 151(2):145–9.
10.. Hlongwa P. Early orthodontic management of Crouzon Syndrome: a case report. J Maxillofac Oral Surg [Internet]. 2009; 8(1):74–6.
11. Carinci F, Pezzetti F, Locci P, Becchetti E, Carls F, Avantaggiato A, et al. Apert and Crouzon syndromes: clinical findings, genes and extracellular matrix. J Craniofac Surg [Internet].2005; 16 (3):361–8.
12. Boulet SL, Rasmussen SA, Honein MA. A populationbased study of craniosynostosis in metropolitan Atlanta, 1989-2003. Am J Med Genet A. 1989; 55:984–91.
13. Renier D, Lajeunie E, Arnaud E, Marchac D. Management of craniosynostoses. Childs Nerv Syst [Internet]. 2000; 16(10–11):645–58.
14. Derderian C, Seaward J. Syndromic craniosynostosis. Semin Plast Surg [Internet]. 2012; 26(2):64–75.
15. Azoulay-Avinoam S, Bruun R, MacLaine J, Allareddy V, Resnick CM, Padwa BL. An overview of craniosynostosis craniofacial syndromes for combined orthodontic and surgical management. Oral and Maxillofacial Surgery Clinics. 2020 May 1; 32(2):233-47.
16. Singer S, Bower C, Southall P, Goldblatt J. Craniosynostosis in Western Australia, 1980–1994: a population-based study. American journal of medical genetics. 1999 Apr 23; 83(5):382-7.
17. reiborg S. Crouzon Syndrome. A clinical and roentgencephalometric study. Scand J Plast Reconstr Surg Suppl 1981; 18:1–198.
18. Kreiborg S, Aduss H. Pre- and postsurgical facial growth in patients with Crouzon's and Apert's syndromes. Cleft Palate J 1986; 23(1):78–90.
19. Am J Med Genet. 1995; 55: 500-504
20. Kaloust S, Ishii K, Vargervik K. Dental development in Apert syndrome. Cleft Palate Craniofac J 1997; 34:117–21.
21. Outlet SL, Rasmussen SA, Honein MA. A population based study of craniosynostosis in metropolitan Atlanta, 1989-2003. Am J Med Genet A 2008; 146: 984–91
22. Pfeiffer Syndrome. In: Diagnostic Imaging: Obstetrics. Elsevier; 2016; 982–5.
23. Hackett A, Rowe L. FGFR1 Pfeiffer syndrome without craniosynostosis: an additional case report. Clin Dysmorphol. 2006; 15:207-10.
24. Stevens CA, Roeder ER. Ser351Cys mutation in the fibroblast growth factor receptor 2 gene results in severe Pfeiffer syndrome. Clin Dysmorphol. 2006; 15:187-8.
25. Huang GJ (2005) Functional appliances and long term effects on mandibular growth. Am J Orthod Dentofacial Orthop 128: 271-272.
26. Factors affecting longterm results in hemifacial microsomia. Cleft Palate J 23: 53-68.
27. Pineau M, Farrow E, Nicot R, Ferri J. Achondroplasia: Orocraniofacial features and orthodontic-surgical management guidelines proposal. Journal of Craniofacial Surgery. 2018 Nov 1; 29(8):2186-91.
28. Rosaline Tina Paul, Biswas P.P., Ligil A.R., Joseph K.Thanikunnel, Hemant Nandan Journal of Contemporary Orthodontics, 2021;5(3):1-6
29. Zhiang R, Thompson LM, Zhu YZ, Church DM, Fielder TJ, Bocian M, et al: Mutations in the transmembrane domain of FGFR3 cause the most common genetic form of dwarfism, achondroplasia. Cell 1994; 78: 335 – 342.
30. Celenk P, Arici S, Celenk C. Oral findings in a typical case of achondroplasia. J Int Med Res 2003;31:236–238
31. Mori H, Matsumoto K, Kawai N, et al. Long-term follow-up of a patient with achondroplasia treated with an orthodontic approach. Am J Orthod Dentofac Orthop 2017;151:793–803
32. Chang H, Wei J, Wang Y, et al. Restorative treatment strategies for patients with cleidocranial dysplasia. Acta Odontol Scand. 2015; 73:447–53.

33. Becker A, Shteyer A, Bimstein E, Lustmann J. Cleidocranial dysplasia: part 2-- treatment protocol for the orthodontic and surgical modality. Am J Orthod Dentofac Orthop. 1997; 111:173–83.

Review Article

Orthodontic Pain Management- A Literature Review

Dr. Suresh Kangne [1], Dr. Trupti Nakhate [2], Dr. Pravinkumar Marure[3], Dr. Swathilekshmi Nair [4], Dr. Aavesh Bhoir [5], Dr. Arsalan Shaikh [6]
[1]Professor & HOD, [2]PG Student, [3] Professor, [4, 5, 6] PG Student
Dept. of Orthodontics, MIDSR Dental College, Latur.

Abstract:
Introduction: Pain is experienced by the patient during the orthodontic treatment. Pain is a subjective response to the noxious stimuli. It varies from patient to patient depending on the various factors such as age, sex, gender, past dental history, anxiety, stress, past medical history or type of appliance used.

Objective: The objective of this literature review is to discuss conventional versus recently introduced modalities in pain management of orthodontic patients.

Conclusion: There are non-pharmacological and pharmacological methods to control pain management in orthodontic patients. Orthodontist must decide which method is best suited for the particular patient depending on the threshold level of individual patient. Further investigations are required in this field.

Keywords: orthodontic treatment, pain management, discomfort

Corresponding Author: Dr. Trupti Nakhate, PG Student, Dept. of Orthodontics, MIDSR Dental College, Latur. Email id.: nakhate.trupti30@gmail.com

INTRODUCTION

The most frequent side effects of orthodontic therapy with fixed appliances are pain and discomfort. Separator placement, within an hour, during the following 24 hours, causes pain during the course of the treatment. Within seven days of initial bonding, initial installation of the wire, or initially placement of the separators, pain lessens. Inflammation, pressure, ischemia, and edema related to tooth movement are some of the causes that contribute to discomfort or pain experienced during treatment. The numeric scale of rating or visual analog scale is the most typical tool for assessing pain intensity.1 Orthodontic pain and discomfort can be managed using both pharmaceutical and non-pharmacological techniques. Additionally, the discomfort brought on by orthodontic treatment causes the patient's lifestyle to change and can cause gingival bleeding, speech impairment, lack of oral hygiene, tooth movement, halitosis, and difficulties eating.2

Patients using fixed appliances experience higher discomfort and pain than those who use removable appliances, according to a number of studies, which demonstrate that aligners give less discomfort and pain than fixed appliances.3

An easy and non-invasive cold pressor test may be done to assess the likelihood that patients receiving orthodontic treatment would experience pain.4,5 There are many techniques that can be used, including anesthesia, painkillers, transcutaneous nerve stimulation (TENS), vibration stimulating of the periodontal ligament, and low-level laser therapy.6 However, taking NSAIDs is the most effective way to manage discomfort during orthodontic treatment. In addition, some patients may experience orofacial pain while undergoing

treatment; in these cases, orthodontists must work with orofacial experts to manage the patient.
The objective of this review is to discuss various methods used to relieve pain during orthodontic treatment.

Classification of orthodontic pain management

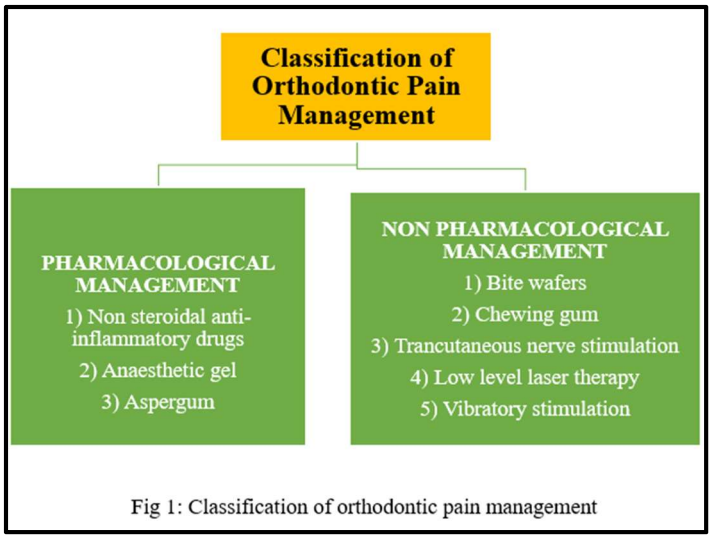


Fig 1: Classification of orthodontic pain management

PHARMACOLOGICAL MANAGEMENT
Analgesics:
Analgesics are mostly used to ease the discomfort brought on by orthodontic treatment. Narcotics (such opiates) and non-narcotics (NSAIDs) make up the majority of the medications for relieving pain. The most popular orthodontic medication is offered as over-the-counter drugs including aspirin, paracetamol, and ibuprofen. To determine whether non-steroidal anti-inflammatory medicines are effective at reducing pain, Angelopoulou et al. carried out a meta-analysis. 7 Seven research out of 1,127 investigations were included. Ibuprofen and acetaminophen had no statistically significant variation in their ability to reduce discomfort during orthodontic treatment. Ibuprofen did, however, appear to lessen the severity of the patient pain within the first two to six hours following the intervention, but not throughout the first 24 hours of treatment, when pain is severe. Therefore, it was determined that ibuprofen reduced discomfort in the early stages of treatment.8

Mechanism of action:
Prostaglandins are typical mediators of pain and inflammation that are generated during the breakdown of an arachidonic acid derivative.9 COX isoenzymes controls the process of synthesis. While COX-2 levels alter during the treatment, COX-1 does not show any alterations. While COX-2 (an inducible isoenzyme) is claimed to arise in response to certain stimuli, COX-1 is reported to release at general equilibrium in a variety of tissues.10,11 According to the premise that selective COX-2 inhibitors, also called "coxibs," will have an anti-inflammatory action without influencing the stomach levels of COX-1 inhibitors.12,13 Coxibs exhibit anti-inflammatory characteristics as a result, but by blocking COX-2, they preserve the COX-1 pathway and the natural synthesis of prostaglandins needed to maintain a healthy gastrointestinal flora.14
NSAIDs are known to inhibit the movement of teeth and increasing the risk of root resorption, according to literature review research.15 Acetaminophen has been demonstrated to be an effective painkiller during orthodontic treatment with no adverse effects on tooth movement, root resorption risk, or oral cavity flora. However, a lot of the information that has been published is still debatable on this subject.
The prophylactic administration of the oxicam derivative meloxicam and the traditional NSAIDs acetaminophen and ibuprofen were compared in a study.16, 17 to reduce the discomfort associated with orthodontic treatment, the patients were given 7.5 mg of meloxicam, 650 mg of acetaminophen, and 400 mg of ibuprofen. According to the study's findings, acetaminophen is a drug of choice for reducing orthodontic therapy pain without influencing the movement of teeth or causing gastrointestinal toxicity. Meloxicam can still be used as a substitute in people for those NSAIDs that are contraindicated because it has the lowest GIT toxicity.
In a study by M. Abu Al-Melh and Anderson, the effectiveness of lidocaine/prilocaine topical anaesthesia was assessed to control the discomfort and pain brought on by the placement of elastomeric separators.1 In comparison to the placebo group, they discovered that there was a reduction in the total discomfort and pain caused on by the placement of separators. Therefore, this may be a useful

technique for patients with low pain thresholds. The explanation of mode of action of NSAIDs in Fig.2:

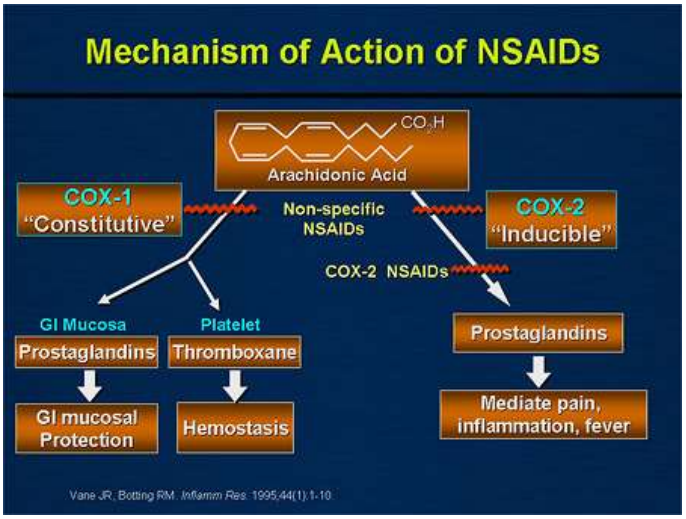


Fig 2: Mechanism of action of NSAIDs19

NON-PHARMACOLOGICAL MANAGEMENT:

One common objective of research in every field of medical science is to obtain efficient relief from pain without the usage of medicines. Because of this, patients undergoing orthodontic treatment may use lasers to manage their pain.20, 21

Patients who have pain can benefit from a single dosage of helium-neon laser therapy. It is one of the most efficient ways to manage discomfort during orthodontic treatment. Compared to the placebo group, the laser therapy patients reported to have less discomfort. However, the study has limitations of its own, and no prior research has been done to compare the efficacy of helium-neon laser treatment to that of other laser types.22

Chewing gum or biting on wafers:

The pain caused by orthodontic treatment can be reduced by chewing gum or wafers. 57 Orthodontic patients participated in a study to determine whether use of chewing gum affects or reduces discomfort for patients receiving orthodontic treatment. The average overall effect score is 16 at 24 hours, whereas the median VAS was 25 mm different between the two groups.23, 24

An investigation into the impact of ibuprofen and sugar-free chewing gum on orthodontic patient discomfort recently was conducted. Patients were split into two groups: the control group, who were only allowed to take ibuprofen, and the experimental group, who were also allowed to chew gum. They concluded that patient using sugar free gum may experience lesser pain without affecting the bond failure rate.

Transcutaneous electric nerve stimulation:

It is one of the non-invasive, nonpharmacological method to reduce the discomfort associated with orthodontic treatment. TENS works primarily by preventing nerve depolarization.25,26 TENS generates an electrical stimulus that moves more quickly than a pain impulse. It enters the dorsal horn and shuts the gate for pain impulses, resulting in a decrease in pain intensity.27

Lasers in orthodontic pain management:

According to the power of the radiation they emit, which might have high, medium, or low intensities, lasers vary according to the radiations. Low level lasers (LLL), also known as soft lasers, therapeutic, or cold lasers, have analgesic, anti-inflammatory, and tissue-stimulating properties, but they do not cause treated tissue to get damage to a temperature of 36.5 degrees Celsius over normal body temperature.28,29

A study by Manoel Brito et al. had 54 participants who were randomly assigned to the laser group or the control group. The laser in question was a gallium-aluminum-arsenide infrared laser with a cross area of 2 mm and a 40-mW power setting. They came to the conclusion that the laser therapy patients reported less pain as compared to the control group at 6, 24, and 48 hours into treatment.30

Low level laser therapy (LLLT):

The introduction of LLLT helps to reduce orthodontic discomfort. Low intensity laser therapy also has analgesic properties and speeds up tooth movement. A metanalysis was performed, and only 14 RCTs (randomized control trials) with a total of 659 participants were included out of 186 results. According to the findings of the study, patients who used an LLLT diode had less pain than those who used a placebo. Studies, however, did not yield sufficient results to support the use of laser treatment to treat pain.31

Behavioural approach:

Physical activity, cognitive behavioral therapy, and music therapy are effective ways to manage pain during orthodontic treatment. Orthodontic patients who experience discomfort can benefit from a psychological perspective and behavioral management. The goal of the study was to improve the patient-doctor connection during the course of treatment. If an orthodontist guides and educates about the discomfort that is expected at the beginning of the treatment, pain can be avoided.

Patients who have higher internal control orientation and personal pain control perception feel less pain than those who do not. By interviewing the patients about their impression of pain prior to the placement of the archwire, a study was conducted to determine the impact of pain. They found that people who anticipated that pain will be more experienced greater intensity of pain and had negative impact of pain in their life style.

Gene therapy:

In order to alter the biological functioning of the target cells, this process involves transporting sequences of DNA or genes to the target cells. Pain reduces when endogenous opioids genes are inserted into the neurons. Gene therapy was utilized to treat cancer in a human clinical trial, and it assisted in reducing discomfort. Herpes simplex virus is used to deliver endogenous opioid genes or RNA interference sequences to the trigeminal ganglia against pro-inflammatory genes like calcitonin gene-associated peptide (CGRP). Due to biosafety concerns, this approach is not, however, routinely used to treat pain. If the biosafety issue is resolved, this approach may also be beneficial in reducing pain.

Dietary modifications:

Dietary changes are most important during orthodontic treatment. Patients need to be inspired to begin healthy eating practices. 180 participants were enrolled in a study to examine the dietary intake of orthodontic patients as well as control subjects. According to the authors, compared to the control group, orthodontic patients consumed much less fibre, chromium, and beta-carotene and significantly more calories in general, proteins, and carbohydrates. Riordan documented how orthodontic treatment affected nutritional consumption. 10 adolescents in total were enrolled in the trial. The comparison of nutritional consumption prior to and following orthodontic treatment was the goal. Using a t-test with two samples having an alpha level of 0.05, recorded diets were analysed. After orthodontic corrections, the data indicated a decrease in magnesium and copper consumption.

Communication:

Nutritional guidance and proper oral hygiene instructions should be given to the patients undergoing fixed orthodontic treatment. A study conducted by Cozzani et all stated that telephone follow-up after the orthodontic treatment is effective in reducing the pain threshold level of the patients. However, it is not possible to take follow up of the patients in this busy schedule post orthodontic follow-up.

CONCLUSION

Orthodontists must evaluate each patient's pain threshold separately using their best clinical judgment. A certain amount of pain and discomfort experienced by patients may be prevented with effective orthodontist-patient communication and dietary recommendations. However, according to the material that is now accessible, analgesics continue to be a reliable and common approach of pain management. Additionally, orthodontists must understand pharmacological activity of each medication as well as the benefits and drawbacks before administering it as an analgesic. For each patient, a maximum advised dose must be taken into consideration. Advanced care management and collaboration with patients' specialists are frequently necessary for those with specific diseases like trigeminal neuralgia or psychological discomfort. However, managing pain is a complicated affair. Nevertheless, pain management is a complex phenomenon. Therefore, further investigations combining different methods of orthodontic pain control with appropriate study designs and large sample sizes are required.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE
Not applicable.

CONSENT FOR PUBLICATION
Not applicable.

CONFLICT OF INTEREST
The authors declare no conflict of interest, financial or otherwise.

REFERENCES

1. Koritsánszky N, Madléna M. Fájdalom és diszkomfort az ortodonciai kezelés során. Irodalmi összefoglalás [Pain and discomfort in orthodontic treatments. Literature review]. Fogorv Sz. 2011 Dec;104(4):117-21
2. Marques LS, Paiva SM, Vieira-Andrade RG, Pereira LJ, Ramos-Jorge ML. Discomfort associated with fixed orthodontic appliances: determinant factors and influence on quality of life. Dental Press J Orthod. 2014 May-Jun;19(3):102-7
3. Sergl HG, Klages U, Zentner A. Pain and discomfort during orthodontic treatment: causative factors and effects on compliance. Am J Orthod Dentofacial Orthop. 1998 Dec;114(6):684-91
4. Zheng B, Ren M, Lin F, Yao L. Prediction of pain in orthodontic patients based on preoperative pain assessment. Patient Prefer Adherence. 2016 Mar 3;10:251-6
5. Romero-Reyes M, Uyanik JM. Orofacial pain management: current perspectives. J Pain Res. 2014 Feb 21;7:99-115
6. Krasny M, Zadurska M, Cessak G, Fiedor P. Analysis of effect of non-steroidal anti-inflammatory drugs on teeth and oral tissues during orthodontic treatment. Report based on literature review. Acta Pol Pharm. 2013 May-Jun;70(3):573-7
7. Angelopoulou MV, Vlachou V, Halazonetis DJ. Pharmacological management of pain during orthodontic treatment: a meta-analysis. Orthod Craniofac Res. 2012 May;15(2):71-83
8. Pozzi A, Gallelli L. Pain management for dentists: the role of ibuprofen. Ann Stomatol (Roma). 2011 Jul;2 (3-4 Suppl):3-24. Epub 2012 Apr 15
9. Vane JR. Inhibition of prostaglandin synthesis as a mechanism of action for aspirin-like drugs. Nat New Biol. 1971 Jun 23;231(25):232-5
10. Ashley PF, Parekh S, Moles DR, Anand P, Behbehani A. Preoperative analgesics for additional pain relief in children and adolescents having dental treatment. Cochrane Database Syst Rev. 2012 Sep 12;(9):CD008392
11. Rao P, Knaus EE. Evolution of nonsteroidal anti-inflammatory drugs (NSAIDs): cyclooxygenase (COX) inhibition and beyond. J Pharm Pharm Sci. 2008 Sep 20;11(2):81s-110s
12. Sostres C, Gargallo CJ, Arroyo MT, Lanas A. Adverse effects of non-steroidal anti-inflammatory drugs (NSAIDs, aspirin and coxibs) on upper gastrointestinal tract. Best Pract Res Clin Gastroenterol. 2010 Apr;24(2):121-32
13. Barkin RL. Topical Nonsteroidal Anti-Inflammatory Drugs: The Importance of Drug, Delivery, and Therapeutic Outcome. Am J Ther. 2015 Sep-Oct;22 (5):388-407.
14. Krasny M, Zadurska M, Cessak G, Fiedor P. Analysis of effect of non-steroidal anti-inflammatory drugs on teeth and oral tissues during orthodontic treatment. Report based on literature review. Acta Pol Pharm. 2013 May-Jun;70(3):573-7
15. Kohli SS, Kohli VS. Effectiveness of piroxicam and ibuprofen premedication on orthodontic patients' pain experiences. Angle Orthod. 2011 Nov; 81 (6):1097-102. doi: 10.2319/022411-134.1. Epub 2011 Jun 6
16. Phillips WJ, Currier BL. Analgesic pharmacology: II. Specific analgesics. J Am Acad Orthop Surg. 2004 Jul-Aug; 12 (4):221-33.
17. Bruno MB, Bruno MA, Krymchantowski AV, da Motta AF, Mucha JN. A double-blind, randomized clinical trial assessing the effects of a single dose of preemptive anti-inflammatory treatment in orthodontic pain. Prog Orthod. 2011; 12(1):2-7.
18. Zarif Najafi H, Oshagh M, Salehi P, Babanouri N, Torkan S. Comparison of the effects of preemptive acetaminophen, ibuprofen, and meloxicam on

pain after separator placement: a randomized clinical trial. Prog Orthod. 2015; 16:34
19. Al-Melh MA, Andersson L. The effect of a lidocaine/prilocaine topical anesthetic on pain and discomfort associated with orthodontic elastomeric separator placement. Prog Orthod. 2017 Dec;18(1):1
20. Keim RG, Managing orthodontic pain Journal of Clinical Orthodontics 2004 38:641-42.
21. White LW, Pain and cooperation in orthodontic treatment Journal of Clinical Orthodontics 1984 18:572-75.
22. Li FJ, Zhang JY, Zeng XT, Guo Y. Low-level laser therapy for orthodontic pain: a systematic review. Lasers Med Sci. 2015 Aug; 30(6):1789-803.
23. Benson PE, Razi RM, Al-Bloushi RJ. The effect of chewing gum on the impact, pain and breakages associated with fixed orthodontic appliances: a randomized clinical trial. Orthod Craniofac Res. 2012 Aug;15(3):178-87
24. Murdock S, Phillips C, Khondker Z, Hershey HG. Treatment of pain after initial archwire placement: a noninferiority randomized clinical trial comparing over-the-counter analgesics and bite-wafer use. Am J Orthod Dentofacial Orthop. 2010 Mar; 137(3):316-23.
25. Ireland AJ, Ellis P, Jordan A, Bradley R, Ewings P, Atack NE, Griffiths H, House K, Moore M, Deacon S, Wenger N, Worth V, Scaysbrook E, Sandy JR. Comparative assessment of chewing gum and ibuprofen in the management of orthodontic pain with fixed appliances: A pragmatic multicenter randomized controlled trial. Am J Orthod Dentofacial Orthop. 2016 Aug; 150 (2):220-7.
26. Boleta-Ceranto Dde C, de Souza RS, Silverio-Lopes S, Moura NC. Orthodontic post-adjustment pain control with acupuncture. Dental Press J Orthod. 2014 Jul-Aug;19(4):100-6
27. Ukra A, Bennani F, Farella M. Psychological aspects of orthodontics in clinical practice. Part one: treatment-specific variables. Prog Orthod. 2011 Nov;12(2):143-8
28. Ashkenazi M, Berlin-Broner Y, Levin L. Pain prevention and management during orthodontic treatment as perceived by patients. Orthodontics (Chic.). 2012;13(1):e76-81
29. Wang J, Jian F, Chen J, Ye NS, Huang YH, Wang S, Huang RH, Pei J, Liu P, Zhang L, Zhao ZH, Chen QM, Lai WL, Lin YF. Cognitive behavioral therapy for orthodontic pain control: a randomized trial. J Dent Res. 2012 Jun;91(6):580-5
30. Sergl HG, Klages U, Zentner A. Pain and discomfort during orthodontic treatment: causative factors and effects on compliance. Am J Orthod Dentofacial Orthop. 1998 Dec;114(6):684-91
31. Kasat V, Gupta A, Ladda R, Kathariya M, Saluja H, Farooqui AA. Transcutaneous electric nerve stimulation (TENS) in dentistry- A review. J Clin Exp Dent. 2014 Dec 1;6(5):e562-8
32. Wang J, Jian F, Chen J, Ye NS, Huang YH, Wang S, Huang RH, Pei J, Liu P, Zhang L, Zhao ZH, Chen QM, Lai WL, Lin YF. Cognitive behavioral therapy for orthodontic pain control: a randomized trial. J Dent Res. 2012 Jun;91(6):580-5
33. Hussain AS, Al Toubity MJ, Elias WY. Methodologies in Orthodontic Pain Management: A Review. Open Dent J. 2017 Aug 31;11:492-497
34. Bicakci AA, Kocoglu-Altan B, Toker H, Mutaf I, Sumer Z. Efficiency of low-level laser therapy in reducing pain induced by orthodontic forces. Photomed Laser Surg. 2012 Aug; 30 (8):460-5.
35. Sonesson M, De Geer E, Subraian J, Petrén S. Efficacy of low-level laser therapy in accelerating tooth movement, preventing relapse and managing acute pain during orthodontic treatment in humans: a systematic review. BMC Oral Health. 2016 Jul 7; 17 (1):11. doi: 10.1186/s12903-016-0242-8
36. Bayani S, Rostami S, Ahrari F, Saeedipouya I. A randomized clinical trial comparing the efficacy of bite wafer and low level laser therapy in reducing pain following initial arch wire placement. Laser Ther. 2016 Jun 29; 25 (2):121-129.
37. Sandhu SS, Cheema MS, Khehra HS. Comparative effectiveness of pharmacologic and nonpharmacologic interventions for orthodontic pain relief at peak pain intensity: A Bayesian network meta-analysis. Am J Orthod Dentofacial Orthop. 2016 Jul;150(1):13-32

Review Article

Orthodontic Treatment Considerations for Medically Compromised Patients: A Review Article

Dr. Pravinkumar Marure [1], Dr. Payal Bhutada [2], Dr. Suresh Kangne [3], Dr. Trupti Nakhate [4],
[1]Professor, [2]PG Student, [3]Professor & HOD, [4]PG Student.
Dept. of Orthodontics, MIDSR Dental College, Latur.

Abstract:

Modern orthodontic practice is increasingly incorporating the treatment of individuals with medical conditions. In most of these disorders, orthodontic treatment is not absolutely contraindicated, but it may still be necessary to modify the treatment strategy. 1. For patients who are medically compromised, early diagnosis and excellent medical management are now possible because of medical advancements. The quality of life is improved, and their life expectancy is increased. Therefore, these patients who have well-controlled medical issues can receive orthodontic therapy.2 It is essential to have complete medical histories. An orthodontist in practice should be well-equipped to handle the difficulties associated with diagnosing and treating patients who have medical problems. Depending on how a specific disease is affecting the oral environment, the treatment strategy should be modified. 3. The medical conditions that orthodontists may encounter are covered in this article. Additionally, the orthodontic treatment plan's suggestions and revisions will be thoroughly explored. This article's goal is to cover common medical disorders and the corresponding orthodontic management standards.

Keywords: Medically compromised patients, orthodontic consideration.

Corresponding Author: Dr. Payal Bhutada, PG Student, Dept. of Orthodontics, MIDSR Dental College, Latur. Email id.: payalbhutada99@gmail.com

INTRODUCTION

Number of people looking for orthodontic treatment has grown during the past few years. Some of them have health issues or take drugs. Orthodontists must be knowledgeable about these issues and understand how to adjust their treatment strategy accordingly. They are required to consult with the patients' doctors regarding certain orthodontic treatments and whether any treatment modifications will be required while the patient is undergoing treatment.1 Since the tissues' ability to respond to orthodontic therapy is compromised during the active or acute phase of an illness, orthodontic treatment is contraindicated during the acute or active phase of any disease process.2 However, most of these disorders are not contraindicated unless they are uncontrolled. The growth responses and the dento-alveolar changes are typically normal in patients who get proper medical care. 3 This article's goal is to cover common medical disorders and the corresponding orthodontic management standards.

The various medical conditions that could influence orthodontic therapy are covered in this article:

1. Diabetes mellitus (DM):

The hallmark of this illness is chronic hyperglycemia, which is an ongoing rise in blood sugar caused by

inadequate insulin. The two primary categories of DM are types 1 and 2. Lack of insulin secretion causes type 1 Diabetes mellitus and resistance to insulin and insufficient insulin production cause type 2 of diabetes mellitus.4

❖ **Orthodontic Considerations:**

Orthodontic therapy is not hazardous for people with well-controlled DM. In order to establish the patient's DM status both before and throughout treatment, discussion with the patient's doctor is necessary. Early morning appointments are preferred, and the patient is advised to take their regular medications and have a regular meal before the session.

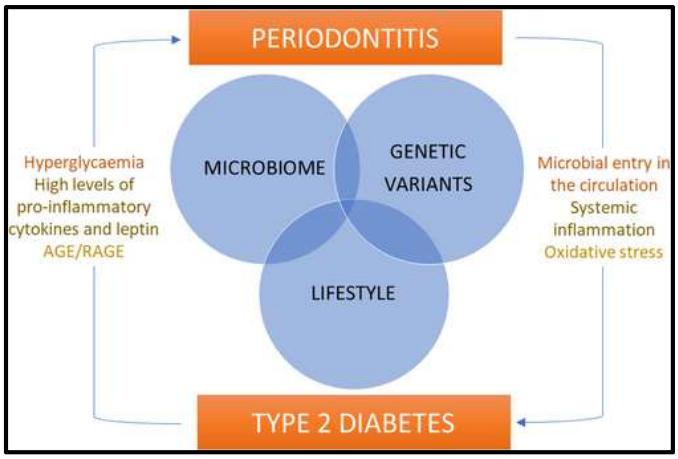


Figure 1: Relationships between type 2 diabetes and periodontitis.

1. It is best to apply mild orthodontic forces.
2. The patient's dental hygiene should be maintained in excellent condition and reinforced each time they visit the office.
3. Any changes in oral hygiene should also be checked on at each appointment.
4. To assess periodontal health prior to and through orthodontic treatment, a periodontist needs to be included, especially for adult patients.5
5. Orthodontists and their staff should be prepared to handle any diabetic situations, particularly those with hypoglycemia.
6. Using an adjuvant mouthwash every day, ideally right before bed, will help to prevent subsequent problems.1

Before beginning orthodontic treatment, it is important to get a full mouth periodontal test which includes probing, plaque scoring and gingival scoring, and to determine whether periodontal therapy is necessary or not, especially in adults. Before receiving orthodontic care, the periodontal problem must be eliminated first. When a patient with diabetes is receiving orthodontic care, the orthodontist should keep an eye on their periodontal health and manage any sign of inflammation.6

2. Thyroid Disorders:

Uncontrolled thyroid hormone synthesis results in hyperthyroidism. Hypothyroidism, on the other hand, is caused by a decrease in the thyroid gland's activity and hormone production. Orthodontic issues that includes hyperthyroidism are, rapid teeth eruption and significant bone turnover. Anterior open bite, macroglossia, delayed tooth emergence, mandibular second molars impaction, and reduced bone turnover are all orthodontic issues associated with hypothyroidism.7

❖ **Orthodontic Considerations:**

1. Stress management techniques should be used with hyperthyroidism.
2. Careful consideration should be given while choosing painkillers for hyperthyroidism.
3. It is not advised to take NSAIDs or aspirin, and other pain relievers like vasopressor amines, epinephrine can be administered under strict supervision.
4. Patients with hyperthyroidism frequently exhibit more tooth movement.
5. Root resorption is more likely to occur in hypothyroid people.8,9

3. Asthma:

This condition is episodic and is caused by airway constriction. These symptoms are typically transitory, this causes breathing difficulties and wheezing. Asthma patients frequently get xerostomia as a result of using steroid-containing inhalers for an extended period of time. Decalcification and periodontal issues are therefore more likely to affect them.10

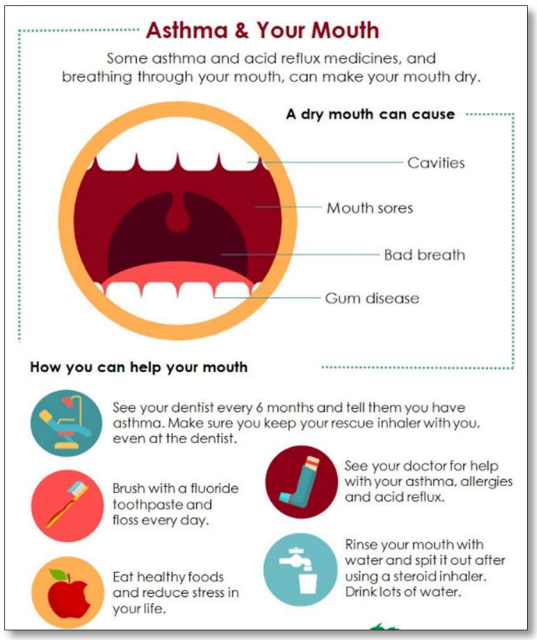


Figure 2: Schematic representation of asthma and oral manifestation

❖ **Orthodontic Considerations:**

1. Anxiety and stress levels should be kept to a minimum because they may trigger an asthma attack.
2. Avoid having the patient lie down during appointments, and schedule brief visits with the patient.
3. If at all feasible, the patient should take their regular medicine prior to the consultation, and if necessary, they should have an inhaler with them.1
4. External root resorption is more likely to occur in people with asthma.11
5. Due to xerostomia, extensive oral hygiene is advised.
6. Because of a potential drug allergy, aspirin and NSAID painkillers should not be used. Patients with asthma are encouraged to take acetaminophen.12

4. Seizure Disorder:

These diseases are brought on by aberrant electrical signals produced by cerebral neurons, which cause rapid, transient, and involuntary abnormalities in neurologic function. They may manifest as sensational, behavioural, or altered states of consciousness. Two or more seizures that are neither induced by, nor related to, acute brain malfunction result in epilepsy.13 Dysfunction in the brain is the cause. Orthodontic issues can include potential face fractures, oral damage, gingival hyperplasia brought on by anticonvulsants, asymmetry of the face, and temporomandibular joint dislocation.14

Figure 3: Gingival enlargement in a patient with seizures.

❖ **Orthodontic Considerations:**

Regarding the level of stability of one's condition, the kind of medication taken, and the patient's medical history, a doctor should be consulted. To define the scope of the orthodontic intervention, it is necessary to first evaluate the type of seizure disorder:

1. It is essential to discuss the chances for lacerations of oral tissues and dental injuries which can develop during orthodontic treatments if seizure episodes take place.
2. Seizures that are well-controlled are not viewed as a barrier to orthodontic treatment.
3. Orthodontic therapy is not recommended for people with uncontrolled seizures who experience episodes of uncontrollable movement of body parts.14
4. These devices should be used carefully, reinforced with additional retention devices, and manufactured of high-impact acrylic resin due to the possibility of removable appliances becoming dislodged during seizure episodes. Fixed orthodontic appliances are therefore advised.
5. Trim the edges of clear aligners carefully near the gingival margins.15
6. Due to the potential for drug-induced gingival expansion, bonded retainers need to be avoided. This

risk can be increased if the retainer is in close proximity to or impinges on the gum.
7. If required, the patient's doctor may ask for a magnetic resonance imaging (MRI). But fixed orthodontic appliances made of metal can cause the MRI to be distorted. In order to obtain a suitable image, it is advised to remove all removable components, especially wires and ligatures.
8. Sometimes it is necessary to remove all appliances and then reinstall them following the MRI. As a result, individuals with these conditions are advised to use titanium, ceramic, or plastic brackets.
9. The orthodontic team should take the following actions if an epileptic episode happens while the patient is there:
Avoid restraint, lay the patient down or to the side, remove any equipment, note the time the seizure began, speak softly, and be next to the patient till he or she is awake. If the seizure lasts longer than ten minutes, or if it is accompanied by apnea, or if more than three episodes take place shortly, call for immediate medical help.14

5. Hemophilia:
A lack of any of the blood's clotting factors causes this illness. A lack of factor VIII and IX is the root cause of hemophilia A and B, respectively. A defect in the Von Willebrand's factor is what leads to Von Willebrand's disease.10

- Orthodontic Consideration:

1. These patients are not prohibited from receiving orthodontic treatment
2. Strict dental hygiene must be practised.
3. Mucosal damage brought on by an orthodontist or orthodontic devices needs to be kept to a minimum.
4. Extra wires should be removed and sharp edges should be softened.16
5. Self-ligating braces are better than conventional ones.
6. Elastomeric ligatures should be used to bind arch wires instead of wire ligatures.
7. The course of treatment should be kept as minimal as possible.10
8. Gingival irritability is more common with removable appliances. Fixed appliances are therefore preferred.
9. If possible, treatment with a non-extraction approach and bonding rather than banding is advised.
10. Non-steroidal anti-inflammatory medicines (NSAIDs) should not be used to treat pain since they are capable of making people more likely to bleed. A safer option is acetaminophen.
11. When taking an impression, a non-metal tray is preferred to a metal one to reduce trauma to soft tissue.
12. A saliva ejector should be positioned on a piece of gauze set on the floor of the mouth during bonding.17

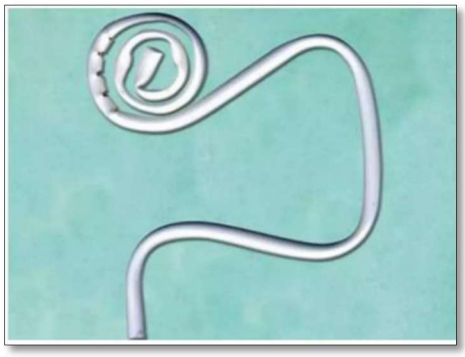


Figure 4: Suction tip for minimizing trauma to floor of mouth

6. Sickel cell anemia:
This genetic disorder is caused by haemoglobin gene mutation, resulting in abnormality of red blood cells. Their capacity and ability to move through the microcirculation is reduced. This causes the blood to become more viscous, clogs capillaries, restricts blood flow to organs, and finally causes discomfort, tissue damage and ischemia.18 Delay in tooth emergence, class II malocclusion, increased overjet, increased overbite, retrognathic mandible, prognathic midface, prognathic maxilla, increased vertical dimension, and convex profile are some common orthodontic features.19

Figure 5: Class II malocclusion with increased overjet and overbite
(Feature of sickle cell anemia)

❖ **Orthodontic Consideration:**

1. Orthodontic therapy is not contraindicated
2. Consultations should be planned in the early hours of the morning, and the patient need to be in a chronic stage of the illness.
3. It is important to reduce mental stress.19
4. If at all possible, treatment with a non-extraction method is preferred.
5. If it is possible, use mild orthodontic forces.
6. Teeth movements with clear aligners should be minimized.
7. Rest intervals during activations should be incorporated into the treatment strategy to allow for the reestablishment of local microcirculation.20
8. During orthodontic procedures, bleeding should be prevented.
9. If additional anchorage is required, extra-oral anchorage is recommended above TADs, and the forces that are applied should be controlled carefully.21

7. Infective Endocarditis:

The endothelium of heart or vessels in the body becomes infected, resulting in this disease. Although this disorder can damage all endothelial-lined surfaces in the ventricles, the atrial chambers and pulmonary arteries, heart valves are particularly susceptible. It has not yet been fully determined how IE and orthodontics are related.22 No significant risk of bacteremia was discovered by the American Heart Association committee when orthodontic appliances were adjusted.23

❖ **Orthodontic Consideration:**

1. Prophylaxis is not advised in routine adjusting of fixed or removable appliances or bracket placement.
2. Any orthodontic operation that can damage the oral mucosa or interfere with the gingival tissues is advised to use prophylaxis. These include the use of temporary anchorage devices, interproximal reduction, and the placement and removal of bands.23
3. The single dose of the prophylactic antibiotic should be administered prior to the treatment or up to two hours later.
4. It should be given to patients with high-risk for six months following the treatment, including those with previous IE, prosthetic valves, disease of the valves, unrepaired or partially corrected cyanotic congenital heart disorder (CHD), and CHD repaired with prosthetic material.
5. The patient's cardiologist should be consulted to establish the risk level and to arrange for a suitable antibiotic prescription based on the proposed orthodontic procedure: amoxicillin is the first choice. In the event of a penicillin allergy, clindamycin may be used.24
6. During treatment, a thorough oral hygiene routine should be observed.
7. Bonded brackets rather than bands are advised.
8. To keep arch wires in place, elastomeric ties are preferred to ligature ties.
9. Sharp edges, such as those on tubes and hooks, should be polished and rounded off.
10. Extra adhesives need to be cleaned and removed.
11. It is best to stay away from fixed acrylic equipment.22, 23

8. Pediatric Cancer Patient:

One in 900 youngsters between the ages of 16 and 44 is now thought to have survived childhood cancer. All forms of juvenile cancer now have a survival rate that is close to 80%. A delayed second round of therapy will be experienced by about 50% of all survivors. Chemotherapy and radiation therapy administered to a developing person will have an impact on their developmental milestones, dental and craniofacial development. Salivary dysfunction may potentially raise the risk of caries. It has been demonstrated that orthodontic therapy has no negative side effects, despite the fact that perfect treatment outcomes are not always obtained.25

❖ **Orthodontic Consideration:**

1. Making use of devices that reduce the possibility of root resorption.
2. Light application of force
3. Accepting a therapeutic outcome compromised by oversimplified mechanics.
4. Finishing the course of treatment earlier than usual
5. Bypassing care for the lower jaw.
6. It is advisable to wait at least two years following the end of cancer treatments before beginning orthodontic treatment. After a mean of 14.1 years, Remington and colleagues reviewed 100 patients who displayed resorption of the roots during appliance therapy. After active therapy was stopped, there was resorption of root, but there was an increasing remodelling of the root.
7. For patients who are at risk for root resorption, it is typically indicated to obtain an apical film after 6 months into ongoing orthodontic therapy.
8. The treatment must be stopped for a period of three months if the film reveals that the bone resorption is advancing.2,25

9. HIV/ AIDS:

The acquired immunodeficiency syndrome (AIDS) is caused by the human immunodeficiency virus (HIV), which is a bloodborne retrovirus affecting the immune system cells, notably the T-helper lymphocytes (CD4+ cells) and macrophages. In these patients, oral lesions are typically the first to be found. These lesions, which have a high viral concentration and a low CD4+ cell count, contain oral candidiasis and hairy leukoplakia. HIV/AIDS patients may develop medical problems and need special care depending on the severity and stage of their infection.26

Figure 6: Oral candidiasis

❖ **Orthodontic Consideration:**

1. HIV individuals who have no symptoms should get standard medical care. Once the potential of a condition known as or thrombocytopenia has been ruled out, these patients can have routine orthodontic therapy. A suitable referral is advised if an oral lesion is found during treatment.
2. People with HIV can take some drugs for a very long time. Some drug interactions should be known to orthodontists.
3. Use cautious when using aspirin and acetaminophen. Acetaminophen actually has the potential to exacerbate anaemia and granulocytopenia brought on by taking zidovudine (Retrovir) medications. Aspirin and NSAIDs must not be taken when there is thrombocytopenia.27,28

10. MOOD Disorders:

These illnesses include major depressive disorder (MDD) and bipolar disorder. MMD is characterised by a number of symptoms, including hopelessness, severe sadness and lack of interest, appetite loss, guilt, suicide thoughts, gloom, and trouble sleeping. Long-lasting episodes of mania and depression alternate with each other in bipolar disorder (manic-depressive disorder).29 Racing thoughts, reduced sleep, irritability, and hunger abnormalities, bipolar illness can present with symptoms of MMD. Orthodontically speaking, these patients frequently skip visits, behave badly when they do, show little compliance, become disinterested in their care, and neglect their oral hygiene. Because orthodontists can spot early signs of various psychiatric problems, they should be concerned about their patients' psychological health.30

❖ **Orthodontic Consideration:**

In order to closely monitor the patient's condition during orthodontic treatment, a tight working connection with the individual's psychiatrist is necessary.

1. Xerostomia, which raises the risk of caries, can be brought on by some drugs used to treat psychiatric disorders. The orthodontic process may be hampered by gingival hyperplasia induced on by other drugs.
2. It is preferable to get these issues under control prior to starting orthodontic treatment.

3. If a mood condition manifests while receiving orthodontic treatment, a psychologist should be referred to right once.30
4. In addition, the orthodontist must determine whether to carry on with orthodontic therapy until the psychological issues have been brought under control.
5. Orthodontic therapy should last a minimum amount of time.30,31

CONCLUSION

Modern orthodontic practice is increasingly incorporating the treatment of individuals with medical conditions. Trend is most likely to persist. When compared to more intrusive dental treatments, orthodontic treatment is normally thought to be low risk; yet, certain orthodontic maneuvers used in fixed therapy may be hazardous to some patient populations. The more crucial part of risk management is prevention. In the patient group with medical complications, a thorough medical history, open contact with the patient's doctor, and clinical attentiveness are essential. If their illnesses are under control, medically compromised individuals can be evaluated and treated in an orthodontic clinic. Before starting orthodontic treatment, it is crucial to communicate with their doctors. It is advised that orthodontists and employees must have a basic understanding of these disorders and be equipped to handle any crises that may arise during orthodontic sessions.

REFERENCES

1. Anjli Patel, Donald J Burden & Jonathan Sandler (2009) Medical disorders and orthodontics, Journal of Orthodontics, 36:sup1, 1-21.
2. Akhoon AB, Mushtaq M, Zameer S. Orthodontic Management of Medically Compromised Patients. J Adv Med Dent Scie Res 2020;8 (3):6-18.
3. Sharma T, Sharma A, Sharma A, Bansal C, Patyal A Orthodontic management in medically compromised patients. Int J Sci Rep 2022;8 (2):57-66.
4. Bensch L, Braem M, Willems G. Orthodontic considerations in the diabetic patient. Semin Orthod 2004; 10:252–258.
5. Burden D, Mullally B, Sandler J. Orthodontic treatment of patients with medical disorders. Eur J Orthod 2001; 23:363–72.
6. Almadih A, Al-Zayer M, Dabel S, Alkhalaf A, Al Mayyad A, Bardisi W, et al. Orthodontic treatment consideration in diabetic patients. J Clin Med Res 2018; 10:77–81.
7. Maheshwari S, Verma SK, Ansar J, Prabhat K. Orthodontic care of medically compromised patients. Ind J Oral Sci 2012; 3:129.
8. Chandna S, Bathla M. Oral manifestations of thyroid disorders and its management. Indian J Endocrinol Metab 2011; 15:S113–6.
9. Carlos Fabuel L, Jiménez Soriano Y, Sarrión Pérez MG. Dental management of patients with endocrine disorders. J Clin Exp Dent 2010; 2:196–203.
10. Sonis ST. Orthodontic management of selected medically compromised patients: cardiac disease, bleeding disorders, and asthma. Semin Orthod 2004; 10:277–80.
11. Haugland L, Kristensen KD, Lie SA, Van devska-Radunovic V. The effect of biologic factors and adjunctive therapies on orthodontically induced inflammatory root resorption: a systematic review and meta-analysis. Eur J Orthod 2018; 40:326–36.
12. Khattri S, Bhardwaj M. Orthodontic management in medically compromised patients. Int J Dent Clin 2012; 4:26–9
13. Sheller B. Orthodontic management of patients with seizure disorders. Semin Orthod 2004; 10:247–51.
14. Fong GC, Mak YF, Swartz BE, Walsh GO, Delgado-Escueta AV. Body part asymmetry in partial seizure. Seizure 2003; 12:606–12.
15. Dillon JA. The importance of a complete medical history in orthodontic treatment planning. The Journal 2015.
16. Grossman RC. Orthodontics and dentistry for the hemophilic patient. Am J Orthod 1975;68: 391–403.
17. Naveen Kumar J, Anil Kumar R, Varadarajan R, Sharma N. Specialty dentistry for the hemophiliac: is there a protocol in place? Indian J Dent Res 2007; 18:48–54.

18. Costa CPS, Carvalho HLCCd, Thomaz EBAF, Sousa SdFC. Craniofacial bone abnormalities and malocclusion in individuals with sickle cell anemia: a critical review of the literature. Rev Bras Hematol Hemoter 2012; 34:60–3.
19. Amoah K, Newman-Nartey M, Ekem I. The orthodontic management of an adult with sickle cell disease. Ghana Med J 2015;49: 214–218.
20. Alves PVM, Alves DKM, de Souza MMG, Torres SR. Orthodontic treatment of patients with sickle-cell anemia. Angle Orthod 2006; 76:269–73.
21. Pithon MM. Orthodontic treatment in a patient with sickle cell anemia. Am J Orthod Dentofacial Orthop 2011; 140:713–9.
22. Goldman ME. 20 - Endocarditis. In: Reich DL, Fischer GW, editors. Perioperative transesophageal echocardiography. Philadelphia: W.B. Saunders; 2014. p. 218–23.
23. Leong JW, Kunzel C, Cangialosi TJ. Manage ment of the American Heart Association's guidelines for orthodontic treatment of patients at risk for infective endocarditis. Am J Orthod Dentofacial Orthop 2012;142: 348–354.
24. Jena AK, Duggal R, Mathur VP, Parkash H. Orthodontic care for medically compromised patients. J Indian Orthod Soc 2004; 38:160.
25. Forsberg CM:Facial growth and morphology in long term survivors after bone marrow transplantation. Eur J Orthod11:332-340,1989.
26. Shiboski CH, Chen H, Secours R, Lee A, Webster-Cyriaque J, Ghannoum M, et al. High accuracy of common HIV-related oral disease diagnoses by non-oral health specialists in the AIDS Clinical Trial Group. PLoS One 2015; 10:e0131001.
27. Moswin AH, Epstein JB. Essential medical issues related to HIV in dentistry. J Can Dent Assoc 2007; 73:945–8.
28. Little JW, Miller CS, Rhodus NL, editors. Little and falace's dental management of the medically compromised patient. 9th ed., St. Louis, Missouri: Elsevier, Inc; 2018.
29. Neeley II, Kluemper WW, Hays GTLR. Psychiatry in orthodontics, part 1: typical adolescent psychiatric disorders and their relevance to orthodontic practice. Am J Orthod Dento facial Orthop 2006; 129:176–84.
30. Tehranchi A, Behnia H, Younessian F. Bipolar disorder: review of orthodontic and orthognathic surgical considerations. J CraniofacSurg 2015;26:1321–5.
31. Ukra A, Bennani F, Farella M. Psychological aspects of orthodontics in clinical practice, part two: general psychosocial well-being. Prog Orthod 2012;13:69–77.

Review Article

Revolution of Artificial Intelligence: A Review Article

Dr. Yatishkumar Joshi [1], Dr. Swathilekshmi Nair [2], Dr. Suresh Kangne [3], Dr. Payal Bhutada [4]
[1]Professor, [2]PG Student, [3]Professor & HOD, [4]PG Student
Dept. of Orthodontics, MIDSR Dental College, Latur.

Abstract:
The use of information technology (IT) in the dental field has increased significantly over the past 25 years and has helped reduce cost, time, dependence on human expertise and medical errors. AI allows examination, organization, representation and cataloguing of medical information. In 2019, Morgan Stanley estimated that global market for AI in health care could surge from $1.3 billion to $10 billion by 2024, growing at an annual compound rate of 40%. There are 2 main categories of AI, Symbolic AI and Machine Learning (ML). ML is a term first phrased by Arthur Samuel in 1952, is the current paradigm. Current orthodontic literature is replete with studies that have documented various applications of AI and ML. The objective of this review article is to summarize recently developed techniques with regards to applications of AI.
Keywords: Artificial intelligence, orthodontics.

Corresponding Author: Dr. Swathilekshmi Nair, Professor, Dept. of Orthodontics, MIDSR Dental College, Latur. Email id.: nairswathi886@gmail.com

INTRODUCTION:

The human brain is one of the most complicated calculators. Unveiling its intricate structure reflects the process of understanding ourselves.1
The use of information technology (IT) in the dental field has increased significantly over the past 25 years and it has helped reduce cost, time dependence on human expertise and medical errors. As it is a subfield of computer science, AI encompasses both hardware and software that can perceive its environment and take action that maximizes its chances of success in attaining its goals.2

Currently, AI based algorithms are involved in everyday technology and are being extensively used in search engines of internet, online assistance and face recognition in various social media platforms. In general, artificial intelligence is described as "computers mimicking human intelligence".

It deals with a variety of information representation schemes, intelligent search methods for solving uncertainty of data and knowledge, different ideas for automated machine.3 Because of its precise methodologies have immense capability to detect and diagnose the lesions of oral cavity which may be unnoticed by the human eye.4

AI is a problem-solving tool which can help and support a orthodontist to provide more better standards of care. It can even assist orthodontists to choose the best mechanotherapy to move a tooth or group of teeth.5

McCarthy in 1956 brought forward the concept of Artificial Intelligence, basically AI is a branch of computer science which deals with developing specialized computers and programs that have the ability to perceive information and reason, and ultimately, convert that information into intelligent actions.6

In 2016, a study by Takada et al stated that AI expert systems with neural network ML could be useful in Artificial intelligence and machine learning is the next new paradigm in our future orthodontics practice which will improve

Orthodontic practice with help of proper input data selection, appropriately organized modelling, & preferable generalization.[7]
This article aims to provide an insight into applications of AI related to orthodontic diagnosis and treatment planning.

APPLICATIONS OF AI IN ORTHODONTICS

Enormous changes have occurred in orthodontic speciality. There is an increase in newer the advances in treatment modalities, patient awareness and usage of digital appliances. All this has given a new dimension in field of orthodontics. A complete conventional method is not feasible in the future. Artificial intelligence-based software systems are showing notable and refined role in the field of orthodontics and are considered as the future of orthodontic applications.

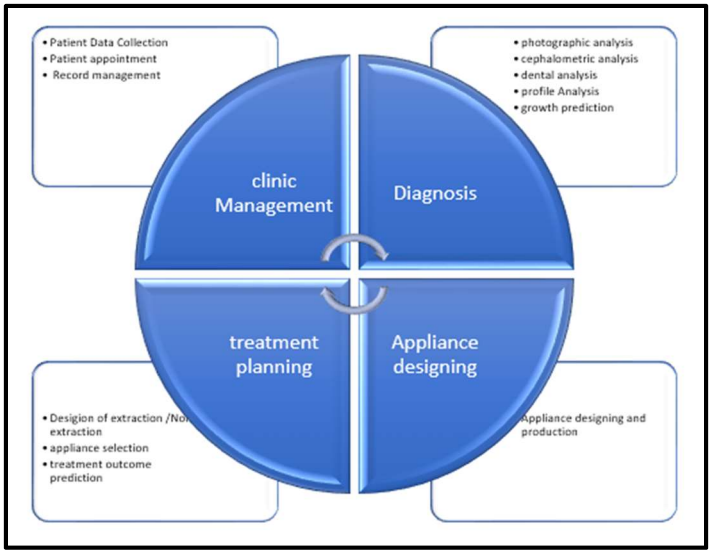


Fig. 1 How AI helps in Orthodontics

1. In management of patient: virtual dental assistants are based on Artificial Intelligence technology are available in the market, these software act as virtual assistants which performs all tasks with high precision and less errors reducing need of manpower in orthodontic clinics.
2. In records : According to Murata et al., 2017 For a clinician, the patient evaluation and taking records are time-consuming steps, AI with automation of diagnosis and imaging increase the speed and accuracy of the evaluation.8
3. In cephalometric analysis: Lee et al. (2020) researched using deep convolutional neural network-based analysis for automated cephalometric tracing& found that the developed software showed high success rate (over 90%) in differential diagnosis of cephalometric landmarks.9
4. In planning orthognathic surgery: Great investment has been made in research and development of digital orthodontics and 3D simulation of orthognathic surgery. 10 According to Bouletreau P, et al, 2019 all the digital tools based on artificial intelligence are able to put marked impact on orthognathic-surgical treatment plans rite from the initial diagnosis to follow-up treatment.11
5. In designing and fabrication of appliances: AI based laboratory designing software will be able to design and fabricate the appliance by maintaining hygiene and precision. 12
6. In prediction of force: Kazem et al. did a study on constructed artificial neural network to evaluate the force system of T - retraction springs where they found that neural network was effective in prediction of force system.13
7. Decision regarding extraction: Jung et al.2016 also constructed neural network model combined with back propagation algorism. The study intended to construct an AI expert system for deciding extraction therapy and extraction pattern. He constructed model showed 93% match for the diagnosis of extraction or non-extraction therapy and 84% for the selection of extraction pattern.14
8. In evaluating the outcome of treatment: in a study did by Nanda SB et al (2015) ahowed that the ANN model analysis was more accurate for the prediction of lip curvature change following extraction and non-extraction orthodontic

treatment as compared to the conventional statistical regression analysis.15

9. Segmentation and landmark identification: Image segmentation is the process where we isolate the targeted organ or lesion from CBCT, X-rays or MRIs.16 Wang et al. developed a method for automated segmentation of both maxilla and mandible by using a CBCT.17 several studies were conducted for looking into automated landmark identification of lateral cephalometric.
   Arik first applied CNNs for automated lateral cephalometric landmark identification.18 Nishimoto used CNNs with personal computer and lateral cephalometric. X-rays gathered through the internet and still get the result without significant difference between AI and hand traced cephalometric landmarks.19
10. Predicting growth: Timing is one of the crucial factor which is considered during any treatment planning, especially for young growing patients. Several methods have been proposed for growth prediction such as chronological age, bone age menarche and change in height and voice. The gold standard for assessing bone age is by hand-wrist radiographs.20 Spampinato used deep learning approaches to assess bone age through hand-wrist radiographs.21
11. Cleft related studies: Zhang collected blood samples from non-syndromic cleft lip and palate infants and healthy infants to validate the diagnostic effectiveness of 43 single nucleotide polymorphisms (SNPs) using genome- wide association.22 Different machine learning algorithms were used to build predictive models with SNPs. The results showed logistic regression was best in risk assessment.
12. TMD Classification: Shoukri et al. applied neural network to stage condylar morphology in temporomandibular joint osteoarthritis (TMJOA). The result of his study suggest that TMJOA can be comprehensively classified by AI.23

CONCLUSION

AI is a human made magnificent tool in the field of Orthodontics. AI has strongly proven its efficient performance with accuracy and precision. It is proved to be a reliable and time saving tool in many aspects AI based simulations for diagnosis and treatment planning has turned out most reliable and time saving.
Refinement with more clinical and theoretical information so digitalization of records in day-to-day clinical practice should be strongly promoted. AI technology coupled with conventional methods should be promoted to make it more accurate and precise.

REFERENCES

1. Hung, Hsien-Ching; Wang, Yi-Chin; and Wang, Yu-Chih (2020) "Applications of Artificial Intelligence in Orthodontics,"Taiwanese Journal of Orthodontics: Vol. 32: Iss. 2, Article 3.
2. Bichu YM, Hansa I, Bichu AY, Premjani P, Flores-Mir C, Vaid NR. Applications of artificial intelligence and machine learning in orthodontics: a scoping review. Prog Orthod. 2021 Jul 5; 22 (1):18.
3. Palanivel J, D. David, Srinivasan D, et al. Artificial intelligence - creating the future in orthodontics - a review. J Evolution Med Dent Sci 2021; 10 (28):2108-2113.
4. Chen YW, Stanley K, Att W. Artificial intelligence in dentistry: current applications and future perspectives. Quintessence Int. 2020; 51(3):248-257. doi: 10.3290/j.qi.a43952. Erratum in: Quintessence Int. 2020; 51(5):430.
5. Faber J, Faber C, Faber P. Artificial intelligence in orthodontics. APOS Trends Orthod 2019;9(4):201-5
6. Haugeland J. "Artificial Intelligence: The Very Idea." Technology and Culture. 1987; 28(4): 905-22
7. Takada K. Artificial intelligence expert systems with neural network machine learning may assist decision-making for extractions in orthodontic treatment planning. J Evid Based Dent Pract 2016; 16(3):190-192.
8. S. Murata, C. Lee, C. Tanikawa and S. Date, "Towards a Fully Automated Diagnostic System for Orthodontic Treatment in Dentistry," 2017

IEEE 13th International Conference on e-Science (e-Science), Auckland, New Zealand, 2017, pp. 1-8.
9. Lee, JH, Yu, HJ, Kim, Mj. et al. Automated cephalometric landmark detection with confidence regions using Bayesian convolutional neural networks. BMC Oral Health 20, 270 (2020).
10. Han S. The fourth industrial revolution and oral and maxillofacial surgery. J Korean Assoc Oral Maxillofac Surg. 2018; 44(5):205-6.
11. P. Bouletreau, M. Makaremi, B. Ibrahim, A. Louvrier, N. Sigaux, Artificial Intelligence: Applications in orthognathic surgery, Journal of Stomatology, Oral and Maxillofacial Surgery, Volume 120, Issue 4, 2019, Pages 347-354.
12. Khan MI, Laxmikanth SM, Gopal T, Neela PK. Artificial intelligence and 3D printing technology in orthodontics: future and scope. AIMS Biophysics. 2022; 9(3):182-97.
13. Kazem, Bahaa I.; Ghaib, Nidahal Hussain; Grama, Noor M. Hasan (2010). Experimental Investigation and Neural Network Modeling for Force System of Retraction T-Spring for Orthodontic Treatment. Journal of Medical Devices, 4(2),
14. Jung SK, Kim TW. New approach for the diagnosis of extractions with neural network machine learning. AmJ Orthod Dentofacial Orthop. 2016; 149(1):127-33.
15. Nanda SB, Kalha AS, Jena AK, Bhatia V, Mishra S. Artificial neural network (ANN) modeling and analysis for the prediction of change in the lip curvature following extraction and non-extraction orthodontic treatment. J Dent Spec. 2015; 3(2):130-9.
16. Hesamian MH, Jia W, He X, Kennedy P. Deep Learning Techniques for Medical Image Segmentation: Achievements and Challenges. J Digit Imaging. 2019 Aug; 32(4):582-596.
17. Wang L, Gao Y, Shi F, Li G, Chen KC, Tang Z, Xia JJ, Shen D. Automated segmentation of dental CBCT image with prior-guided sequential random forests. Med Phys. 2016 Jan; 43(1):336.
18. Arık SÖ, Ibragimov B, Xing L. Fully automated quantitative cephalometry using convolutional neural networks. J Med Imaging (Bellingham). 2017;4(1):014501
19. Nishimoto S, Sotsuka Y, Kawai K, Ishise H, Kakibuchi M. Personal Computer-Based Cephalometric Landmark Detection With Deep Learning, Using Cephalograms on the Internet. J Craniofac Surg. 2019 Jan; 30(1):91-95.
20. Cericato GO, Bittencourt MAV, Paranhos LR. Validity of the assessment method of skeletal maturation by cervical vertebrae: a systematic review and meta-analysis. Dentomaxillofac Radiol. 2015; 44(4):20140270.
21. Spampinato C, Palazzo S, Giordano D, Aldinucci M, Leonardi R. Deep learning for automated skeletal bone age assessment in X-ray images. Med Image Anal. 2017;36:41-51
22. Zhang SJ, Meng P, Zhang J, Jia P, Lin J, Wang X, et al. Machine learning models for genetic risk assessment of infants with non-syndromic orofacial
23. Cleft. Genomics Proteomics Bioinformatics. 2018;16(5):354-64
24. Shoukri B, Prieto JC, Ruellas A, Yatabe M, Sugai J, Styner M, et al. Minimally invasive approach for diagnosing TMJ osteoarthritis. J Dent Res. 2019;98(10):1103-11

Review Article

Smile without Limitations: Exploring the Benefits of Smileloc Abutment System over Traditional Whole Prosthesis in Dental Implant Restorations

Dr. Sandeep fere[1], Dr. Ajit Jankar [2], Dr. Bhushan Bangar [3], Dr. Pratish Kawade [4] Dr. Nitin Kale [5], Dr. Jayshree Ghuge [6]
[1] Reader, [2]Professor & HOD, [3]Professor, [4, 5, 6] PG Student
Dept. of Prosthodontics, MIDSR Dental College, Latur.

Abstract:

Prosthetics are attached to dental implants using cement- and screw-based retention mechanisms, although each technique has the potential to cause clinical issues including implantitis or crown fracture. In order to maintain the retrievability of screw-retained restorations while achieving the aesthetics and retention force of cement-based fixation, a unique abutment and prosthesis retention system has been developed.

It combines the benefits of screws (retrievability) and cement (occlusion, aesthetics), while removing the drawbacks of composite resins and residual cement. This novel solution comprises of an abutment that is precisely machined to fit into the majority of commercial dental implant fittings. The abutment is compatible with a shape memory sleeve.

Keywords: Abutment, shape-memory implant, screw-retained, cement-retained, nitinol.

Corresponding Author: Dr. Nitin Kale, PG Student, Dept. of Prosthodontics, MIDSR Dental College, Latur. Email id.: nkale5127@gmail.com

INTRODUCTION

Dental implants have successfully expanded the range of restorative treatments available for treating both completely and partially edentate individuals, restoring both their masticatory function and aesthetics. Over the course of around 50 years, restorative procedures and materials evolved alongside implant dentistry to meet the high demands of numerous difficult clinical situations1.

There are currently more than 90 manufacturers of implants in the globe, and each one has a unique set of parts or variants that make it special. This situation presents a challenge for the clinician in terms of choosing an adequate abutment to complete the case successfully, particularly if the implant placement was difficult or compromised.

This paper, thus, aims to aid the clinician in various types of implant abutment and clinical application of a shape memory implant abutment system.

DENTAL ABUTMENT

The link between the implant and the restoration is called an implant abutment, and the effectiveness of

implant prosthesis depends on the choice of this abutment. The market offers a wide variety of implant abutments. To pick the appropriate abutment, a clinician should be well-versed on both these abutments and the different variables that influence abutment selection. According to GPT 9 implant abutment is defined as, "the supplemental component of a dental implant that is used to support and/ or retain any fixed or removable dental prosthesis2."

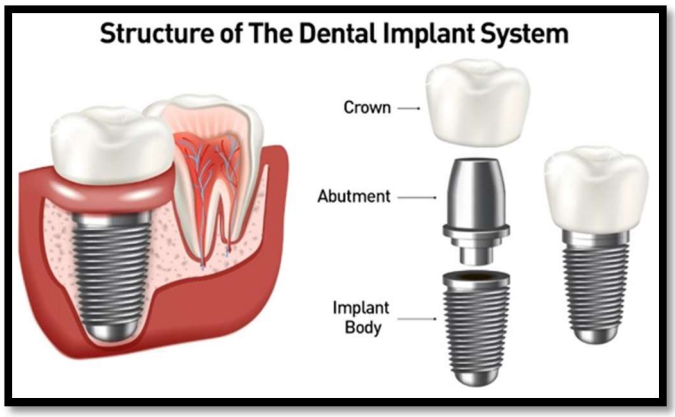


Fig. 1: Structure of the dental implant

Generally dental abutments are categorized into following types3:

Sr. No	Category	Options
1.	Method of connection to Restoration	One-piece screw-retained abutment-crown complex
		Two-piece design with screw-retained crown over the abutment
		Two-piece design with cemented crown over the abutment
2.	Material	Titanium
		Cast metal (noble, high noble, or base metal alloy
		Cast metal with porcelain fused at the base Alumina
		Complete zirconia
		Zirconia with a titanium base (zirconia-titanium hybrid abutment)
3.	Method of fabrication	Prefabricated (unmodified or modified)
		Customized cast abutment
		Customized copy-milled abutment
		Customized CAD-CAM abutment
4.	Colour	Gold
		Silver (metallic finish)
		Pure white
		Customized white
		Customized pink/gingival shade at the cervical region

SCREW RETAINED VS. CEMENT RETAINED IMPLANT RESTORATION:

Dental prosthesis supported by implants is held in position using screw- and cement-based techniques. Both methods have benefits and drawbacks.

In principle, retrievability from screw-retained implant restorations allows for simple examination of underlying parts. Due to the time-consuming nature of screw removal, reinsertion, and occlusal hole restoration, screw retrieval is often only done to fix broken or damaged components4. When tightening screws on multiunit fixed prostheses, residual stress might be significantly increased if the framework and implants are not passively fitted. Additionally, the composite resin materials used to cover the screw access holes are brittle and do not provide durable occlusion control5.

The failure of the prosthetic materials, loosening of the prosthetic screw6, and fracture are drawbacks of screw-retained implants7.

In addition to enabling improved anterior aesthetics and allowing a restoration when implant angulation would position the access hole on the labial surface, cement also allows for better control over occlusion. Because cement fills up the misfit areas between the abutment and the restoration, a passive fit for multiunit prostheses is no longer as important8.

The two main drawbacks of cemented restorations are sub-gingival cement residue and irretrievability9. Due to the absence of irretrievability, it is impossible to repair high-temperature porcelain or tighten implant abutment screws without first drilling a hole through the restoration10. The crown may not fully seat during cementation due to hydrostatic pressure, which will cause hyperocclusion9.

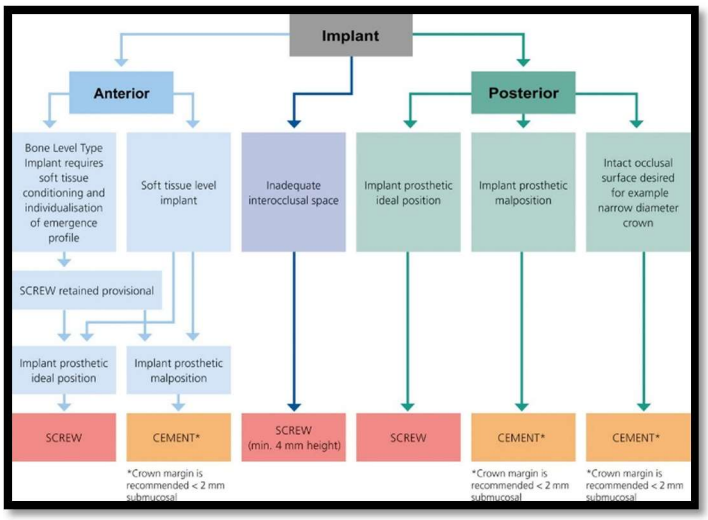


Fig.2. Decision tree illustrating the pathway of decisions in respect of the indication of screw vs. cementation in fixed prosthodontics supporting implants[11]

SHAPE MEMORY ABUTMENT:

A new implant retention method has been developed to overcome these acknowledged difficulties. It combines the benefits of screws (retrievability) and cement (occlusion, aesthetics), while removing the drawbacks of composite resins and residual cement. This novel solution comprises of an abutment that is precisely machined to fit into the majority of commercial dental implant fittings. The abutment is compatible with a shape memory sleeve (Smileloc; Rodo Medical) that has two sets of adjustable flaps that can switch between locking and unlocking the restoration in the "engaged" and "disengaged" positions.

Fig.3 Occlusal and profile view of Smileloc Sleeve

The sleeve is made of nitinol, a nickel-titanium alloy with superelastic properties that is frequently used in interventional cardiology devices and has been shown to be human biocompatible. In dentistry, nitinol orthodontic arch wires and endodontic instruments make use of these superelastic properties12. When used to secure a crown, nitinol is more powerful than attaching screws or cement in addition to being superplastic and capable of changing shape thanks to shape memory13. In the same way that a cemented method is operable, shape memory is also operative if abutment alignment and draw are present in the restoration14.

This abutment design makes use of the shape memory capabilities of nitinol, wherein the sleeve mechanically deforms to one shape at ambient temperature and then returns to its original, unreformed shape upon heating to a temperature above its transformation temperature12.

Items	Advantages	Disadvantages
Cement	Ease of fabrication and clinical steps similar to other indirect restorations	Risk of peri-implantitis
	Control of occlusal contact	
	Restoration without an occlusal hole	
Screw	Retrievable	Occlusal contact interference with screw access channel
		Higher risk of porcelain chipping/fracture
Friction	Control of occlusal contact	Need to tap the restoration on and off
	Restoration without an occlusal hole	
Shape-memory sleeve	Retrievable	Need of an additional activator device to unlock the restoration[15]
	Ease of fabrication and clinical steps similar to other indirect restorations	
	Control of occlusal contact	
	Restoration without an occlusal hole	

The ability to retrieve shapes from memory is one of its most important aspects. The Smileloc changes form and releases the crown for simple retrieval after 5 seconds of use of an electromagnetic wand. Once retrieved, a restoration may be fixed, cleaned, and a new Smileloc triggered to reconnect the crown in a matter of seconds14.

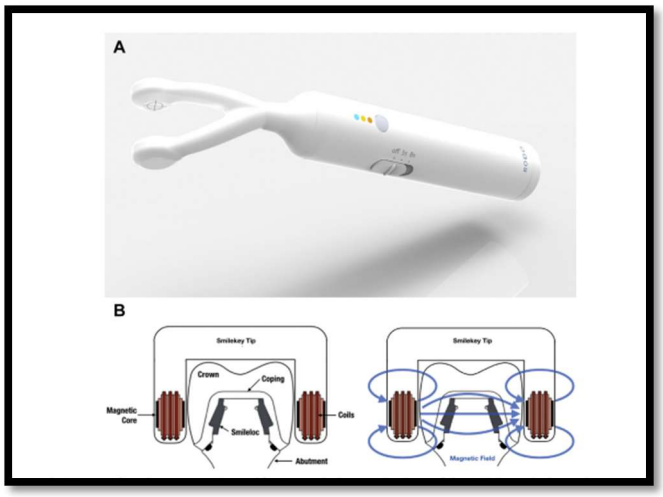


Fig. 4 Use of an electromagnetic wand for 5 seconds changes the shape of the Smileloc and releases the crown for easy retrievability as shown in (A, B).

SUMMARY

This revolutionary abutment technology combines cement-retained prostheses' aesthetics, convenience of use, occlusion control, and retrievability with screw-retained abutments' ability to be easily removed. Occlusal composite resins are not necessary and there is no chance of subgingival residual cement with the shape memory abutment. These definite benefits warrant further thorough research, a lengthier clinical assessment, and a more thorough examination of physical, electrochemical, and biological performance.

REFERENCES

1. Shah RM, Aras MA, Chitre V. Implant-abutment selection: a literature review. Int J Oral Implantol Clin Res. 2014 May; 5(2):43-9.
2. Ferro KJ, Morgano SM, Driscoll CF, Freilich MA, Guckes AD, Knoernschild KL, McGarry TJ, Twain M. The glossary of prosthodontic terms.
3. Bidra AS, Rungruanganunt P. Clinical outcomes of implant abutments in the anterior region: a systematic review. Journal of Esthetic and Restorative Dentistry. 2013 Jun; 25(3):159-76.
4. Beumer J, Faulkner RF, Shah KC, Moy PK. Fundamentals of implant dentistry. Quintessence Publishing Co. Inc.; 2015.
5. Taylor TD. Prosthodontic complications associated with implant therapy. Oral and Maxillofacial Surgery Clinics of North America. 1991 Nov 1; 3(4):979-91.
6. Ohrnell LO, Hirsch JM, Ericsson I, Brånemark PI. Single-tooth rehabilitation using osseointegration. A modified surgical and prosthodontic approach. Quintessence international (Berlin, Germany: 1985). 1988 Dec 1; 19(12):871-6.
7. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications with implants and implant prostheses. The Journal of prosthetic dentistry. 2003 Aug 1; 90(2):121-32.
8. Khraisat A, Jebreen SE, Baqain ZH, Smadi L, Bakaeen L, Abu-Hammad O. Multicenter retrospective study of cement-retained implant-supported anterior partial prostheses: success and restoration evaluation. International Journal of Oral & Maxillofacial Implants. 2008 Aug 1; 23(4).
9. Nissan J, Narobai D, Gross O, Ghelfan O, Chaushu G. Long-term outcome of cemented versus screw-retained implant-supported partial restorations. International Journal of oral and maxillofacial implants. 2011 Sep 1; 26(5):1102.
10. Gervais MJ, Wilson PR. A rationale for retrievability of fixed, implantsupported prostheses: a complication-based analysis. Int J Prosthodont 2007; 20:13-24.
11. Wittneben JG, Joda T, Weber HP, Brägger U. Screw retained vs. cement retained implant-supported fixed dental prosthesis. Periodontology 2000. 2017 Feb; 73(1):141-51.
12. Shah KC, Seo YR, Wu BM. Clinical application of a shape memory implant abutment system. The Journal of Prosthetic Dentistry. 2017 Jan 1; 117(1):8-12.
13. Richter EJ. In vivo vertical forces on implants. International Journal of Oral & Maxillofacial Implants. 1995 Jan 1; 10(1).
14. Jensen OT, Jansen CE, Seo Y, Yellich G. Guided nitinol-retained (Smileloc) single-tooth dental restorations. Oral and Maxillofacial Surgery Clinics. 2019 Aug 1; 31(3):437-46.
15. Shah KC, Choi K. Shape memory attachment as a possible modality to prevent peri-implant disease—a narrative review.