Vol. 4 | Issue 2 | Dec 2025

IJO JOURNAL

Indian Journal of Odontostomatology

www.sgdc.ac.in

A St.Gregorios Dental College Publication

Indian Journal of Odontostomatology

The Journal of St.Gregorios Dental College

December 2025 ❖ Vol. 4 ❖ Issue No.2

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Contents

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EDITORIAL

The advancement of dentistry relies greatly on continuous learning, scientific research, and the adoption of innovative clinical practices. Indian Journal of Odontostomatology serves as an academic platform that highlights contemporary developments in dental science and encourages the exchange of knowledge among researchers, clinicians, and students. This journal presents scholarly articles focused on recent innovations in dentistry, emerging technologies, and interdisciplinary approaches aimed at improving oral healthcare delivery.

As dental education and clinical practice continue to evolve, the importance of research, collaboration, and evidence-based practice becomes increasingly significant. By fostering these principles, we can contribute to improved patient care, strengthen academic growth, and inspire future advancements in oral healthcare. Maintaining originality and ethical academic standards remains an essential aspect of scientific publishing, and plagiarism screening systems continue to support the integrity and quality of published work.

I extend my sincere gratitude to the Management, Principal Prof. Dr. Jain Mathew, Vice Principal Dr. Tina Elizabeth Jacob and Associate Editor, Dr.Ancy Kuriakose of St. Gregorios Dental College for their constant encouragement and valuable support in the successful completion of this journal issue. I would also like to acknowledge the dedicated contributions of Dr. Snigdha Jayaraj and Dr. Nakul P.G for their commitment, enthusiasm, and support throughout the editorial and publication process.

Dr. Merin K Joseph
Editor

***Publication Type**: ORIGINAL RESEARCH*

COMPARISON OF SHEAR BOND STRENGTH, MICROLEAKAGE AND FRACTURE RESISTANCE OF BULK-FILL COMPOSITE ON CLARK'S CLASS II CAVITY CONFIGURATION PLACED USING INJECTION MOLDED TECHNIQUE AND BULK-FILL TECHNIQUE: AN IN-VITRO STUDY

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Abstract

Objective

To compare the shear bond strength, microleakage and fracture resistance of 3M ESPE Filtek Bulk-fill Composites on Clark's class II cavity configuration placed using Injection moulding technique and Bulk-fill technique.

Study Design

Class II cavities with Clark's configuration were prepared on the mesial surfaces of selected 90 Premolars which were mounted on acrylic blocks. A Polyester matrix band was used as a matrix. Cavities were etched with 37% phosphoric acid for 20 seconds and rinsed with water and blot dried. Bonding agent was applied to the dentin surface. In Group 1(Injection molded technique) flowable composite was injected in to the cavity filling approximately 1/3rd. Preheated bulk-fill composite (at 65 degree Celsius) was injected with pressure using a composite gun in to the pool of flowable composite displacing most of the flowable composite. The excess composite was removed and 3 point curing of 20 seconds each was done. In Group 2 (Bulk-fill technique) the composite was placed in a bulk of 4-5 mm and cured for 40 sec. All Specimens were subjected to thermocycling for 1500 cycles between 5-55 degree Celsius. Both Group 1a and Group 2a were subjected to shear bond strength testing using Universal testing machine. Both Group 1b and Group 2b were immersed in 0.5% methylene blue dye for 24 h, rinsed under running water to remove the dye, and dried at room temperature and evaluated with a stereomicroscope at (50x) magnification. Both Group 1c and Group 2c were subjected to fracture resistance testing using Universal testing machine.

Results

Based on the result statistical analysis was done, it was concluded that Clark's Class II cavity restored with bulk-fill composite using Injection molded technique have higher shear bond strength, lower microleakage and higher fracture resistance compared to that of Clark's Class II cavity restored with bulk-fill composite using Bulk-fill technique.

Conclusion

Hence within the limitation of the study it can be concluded that, Preheating Bulk-fill composite and placing it using Injection molded technique in Clark's Class II cavity has a positive effect on shear bond strength, microleakage and fracture resistance.

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INTRODUCTION

Over the years, different composite filling techniques and different modifications in composite resins have been developed in order to minimize polymerization shrinkage and its clinical effects.[1] The latest trend in composite technology is the development of "bulk-fill" composites.[2] These new materials were created in order to cure up to 4-5 mm depth.[3] The deeper cure in bulk-fill composites is made possible by an additional germanium based initiator system which has a higher photocuring activity than camphoroquinone.[4] Studies have shown that 4-5 mm thickness of bulk-fill composite can be placed and cured in one step without negatively affecting the polymerization shrinkage, cavity adaptation, or degree of conversion.[5] Thus, time consuming layering process can be eliminated. Moreover, studies have shown that the polymerization shrinkage of these materials is lower when compared to conventional resin based composites.[6]

The configuration of the cavity plays a crucial role in the durability of the restoration. Conventional Class II cavity preparations are inappropriate for composite resin restorations because of the extensive cavity form, large occlusal area particularly in the areas of occlusal contact, and compromised gingival enamel.[7] A box like cavity in the proximal areas is suitable only for small interproximal lesions[35] but the box preparation of a conventional Class II creates sharp internal line angles, promotes crack initiation, leaves the dentin vulnerable to fracture causing failure of restoration.[8]

Drawbacks of packable composites like high viscosity and stickiness make them difficult for handling and manipulating, resulting in deficient marginal adaptation to prepared walls.[9] Flowable composite could minimize the gaps between the tooth and the restoration, due to their greater flowability. However, their low filler content may cause higher net shrinkage, degrading the mechanical properties of restoration.[10]

Injection molded technique is a modified technique for composite placement introduced by Dr. David Clark, a pioneer in the field of Adhesive Restorative Dentistry. It reduces the potential for voids and fault lines while maintaining the structural integrity of the tooth. This technique involves the use of a redesigned cavity preparation, a translucent matrix system and the proper combination of preheated packable and flowable composites in order to create strong and esthetic restorations.[11] This technique is becoming popular among Dentists, but there is insufficient literature regarding the Injection Molded Technique, as there are no other supporting studies about this method aside from David Clark's.

So, in this study, we will be comparing the shear bond strength, microleakage and fracture resistance of Bulk-fill composite on Clark's Class II cavity configuration, placed using Injection molded technique and Bulk-fill technique.

MATERIALS AND METHODS

90 Human permanent premolars (Fig 1), freshly extracted for orthodontic purposes were collected. Teeth were mounted on acrylic blocks and specimens were subsequently assigned to 6 group (n = 15). Teeth were stratified in order to have similar averages of tooth dimensions in each group so that the influence of size and shape variations on the results are minimized.

The teeth are randomly assigned to 2 groups based on Method of composite placement-

GROUP 1- Injection Molded Technique (n = 45)
Sub-Group 1a – Shear bond strength (n = 15)
Sub-Group 1b – Microleakage (n = 15)
Sub-Group 1c – Fracture resistance (n = 15)

GROUP 2- Bulk-fill Technique (n = 45)
Sub-Group 2a – Shear bond strength (n = 15)
Sub-Group 2b – Microleakage (n = 15)
Sub-Group 2c – Fracture resistance (n = 15)

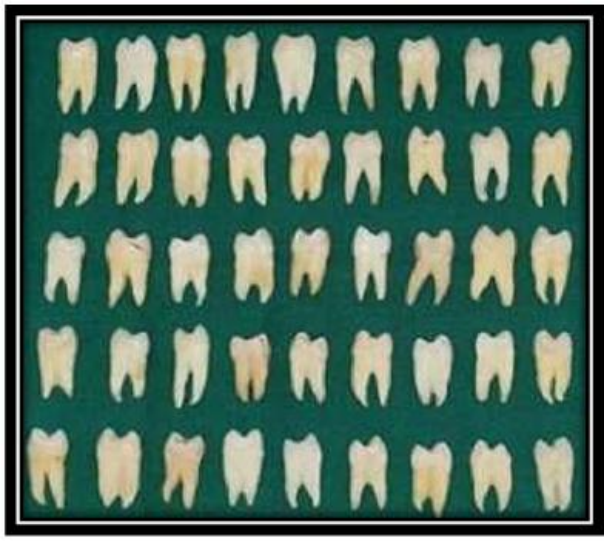

FIG 1: Tooth samples

CLARKS CLASS II CAVITY DESIGN

Class II cavity with Clark's configuration was prepared on the mesial surface of all the selected Premolars. Each cavity had a standard buccolingual width of 2 mm (FIG 2), axial depth of 1.5 mm and an occluso-gingival height of 3.5 mm (FIG 3). The occlusal, proximal, and gingival margins of the cavity preparation had disappearing/serpentine margins in enamel approximately 3 mm.

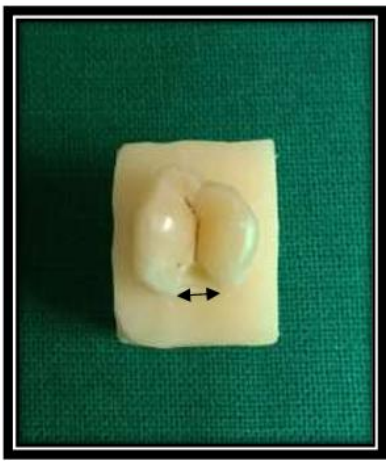

FIG 2: Buccolingual width of 2 mm

FIG 3: Occluso-gingival height of 3.5 mm

PREHEATING PROTOCOL

3M Bulk-fill Composites was taken, placed in a composite warmer (FIG 4) at 65 degree Celsius and then placed immediately in the prepared Class II cavity.

FIG 4: Composite Warmer

GROUP 1

- Clark's Class II cavity was prepared on 45 premolars
- A Polyester matrix band was used as a matrix around the tooth
- The Cavity was etched with 37% phosphoric acid for 20 seconds, rinsed with water and blot dried
- Bonding agent was applied to the dentin surface
- Flowable composite was injected to approximately 1/3rd of the prepared cavity.
- Preheated bulk-fill composite was injected with pressure using a gun (Fig 5) into the pool of flowable composite (Fig 6), displacing most of the flowable composite.
- Excess composite was removed and a 3-point curing of 20 secs each was done.
- Specimens were subjected to thermo-cycling for 1500 cycles between 5-55 degree Celsius, with a dwelling time of 20 secs and a transferring time of 10 secs.

GROUP 2

- Clark's Class II cavity was prepared on 45 premolars.
- A Polyester matrix band was used as a matrix around the tooth.
- Cavity was etched with 37% phosphoric acid for 15 seconds, rinsed with water and blot dried.
- Bonding agent was applied to the dentin surface and light cured for 20 seconds.
- The composite was then placed in a bulk of 4 mm and cured for 40 sec.
- Specimens were subjected to thermo-cycling for 1500 cycles between 5 – 55 degree Celsius, with a dwelling time of 20 secs and a transferring time of 10 secs.

FIG 5: Bulk-fill composite and composite gun

FIG 6: Flowable composite

SHEAR BOND STRENGTH MEASUREMENT

Universal Testing Machine (FIG 7) was used for Shear bond strength measurements. The specimen teeth were positioned in the sample holder of the testing machine at an angulation of 45 degree and the chisel-shaped loading piston is placed on the tooth-restoration interface (FIG 8). Shear loading was applied to the tooth-restoration interface at a crosshead speed of 1 mm/min until debonding occurred. Load at debonding was recorded and bond strength values in MPa were calculated according to the equation:

Bond strength = F/A

F: Load at fracture(N)

A: Adhesive area (mm2)

FIG 7: Universal Testing Machine

FIG 8: Chisel shaped loading piston

MICROLEAKAGE MEASUREMENT

The restored Premolars were immersed in 0.5% methylene blue dye (FIG 9) for 24 h, rinsed under running water to remove the dye, and dried at room temperature. To measure the extent of microleakage; teeth were sectioned longitudinally through the restorations in a mesiodistal direction with a low speed diamond saw Isomet (FIG 10).

The sectioned teeth were evaluated with a stereomicroscope at (50x) (FIG 11) magnification.

The degree of microleakage was determined by the extent of dye penetration (FIG 12) and was scored according to scoring criteria (0 to 3) as followed

Score 0 = No dye penetration

Score 1 = Dye penetration up to one-third of the cavity wall

Score 2 = Dye penetration of more than one-third, but less than two–thirds of the cavity wall

Score 3 = Dye penetration more than two-thirds, or to the full extent of the cavity wall

FIG 9: 0.5% Methyl

FIG 10: ISOMET 5000

FIG 11: Stereomicroscope

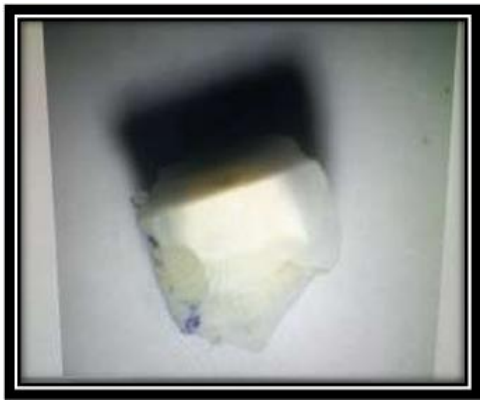

FIG 12: Extent of dye penetration

FRACTURE RESISTANCE MEASUREMENT

The fracture resistance of the teeth was measured using Universal Testing Machine. Each specimen was subjected to compressive loading (FIG 13) using a 5 mm round diameter stainless steel ball (FIG 14) at a strain rate of 2 mm/min. The ball was made to contact the inclined planes of the facial and palatal cusps beyond the margins of the restoration to simulate the tendency of the masticatory forces deflecting the cusps under stress. The force necessary to fracture the specimen was recorded in Newton (N), and the data obtained was tabulated.

FIG 13: Specimen subjecting to compressive loading

FIG 14: Ball shaped loading piston

SHEAR BOND STRENGTH MEASUREMENT

TABLE 1: SHEAR BOND STRENGTH OF GROUP 1a AND GROUP 2a

DESCRIPTIVE STATISTICS					
	N	**Minimum**	**Maximum**	**Mean**	**Std Deviation**
Group 1a	15	3.12	8.08	4.6238	1.25086
Group 2a	15	1.86	4.98	3.5190	0.91140
Valid N	15				

TABLE 2: INDEPENDENT SAMPLES T TEST

	Levene's Test for Equality of Variances		**T- Test for equality of Means**						
	F	**Sig**	**t**	**df**	**P Value Sig.**	**Mean**	**Std Deviation**	**95% Confidence Interval of the Difference**	
								Lower	**Upper**
Equal variances assumed	0.538	0.469	2.76	28	0.010	1.10477	0.399	0.286	1.923
Equal vaiances not assumed			2.76	25.5	0.010	1.10477	0.399	0.286	1.926

MICROLEAKAGE MEASUREMENT

TABLE 3: MICROLEAKAGE SCORES OF GROUP 1b AND GROUP 2b

Groups	**n**	**Mean**	**SD**
Group 1b	15	2.36	1.98
Group 2b	15	2.91	1.97

TABLE 4: MANN-WHITNEY U TEST

Groups	**N**	**Mean Rank**	**Sum of Ranks**	**Mann-whitney u**	**P value**
1b	15	14.83	222.50	102.500	0.650
2b	15	16.17	242.50		
Total	30				

FRACTURE RESISTANCE MEASUREMENT

TABLE 1: SHEAR BOND STRENGTH OF GROUP 1a AND GROUP 2a

Group	N	Mean	Std Deviation	Std Deviation Mean
1c	15	387.5017	84.05413	21.70268
2c	15	320.3722	84.72029	21.87469

TABLE 2: INDEPENDENT SAMPLES T TEST

	Levene's Test for Equality of Variances		T- Test for equality of Means						
	F	Sig	t	df	P Value Sig.	Mean	Std Deviation	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	0.000	0.992	2.179	28	0.038	67.12947	30.81409	4.00966	130.24927

RESULTS

From Table 1 and 2, we can see that there was a significant difference between the Group 1a and Group 2a regarding the shear bond strength with p value=0.01. Since p value was ≤.0.05, it revealed that teeth restored with Injection molded technique (Group 1a) showed a higher shear bond strength than teeth restored with Bulk-fill technique (Group 2a).

From Table 3 and 4, we can see that there was a difference between Group 1b and Group 2b regarding microleakage with a p value of 0.65. Since P ≥0.05, it revealed that the microleakage in Class II cavities restored with Injection molded technique (Group 1b) was comparable with that of Class II cavities restored with Bulk-fill technique (Group 2b)

From Table 5 and 6, we can see that there was a significant difference between Group 1c and Group 2c regarding the fracture resistance with a p value of 0.038. Since p value was ≤.0.05, it revealed that teeth restored with Injection molded technique (Group 1c) have higher fracture resistance than teeth restored with Bulk-fill technique (Group 2c).

DISCUSSION

The use of resin composite restorations has become widespread due to their adequate mechanical behavior and attractive aesthetic characteristics. Bulk-fill composite resins were introduced to enable the clinician to use thicker layers of composite filling materials in increments of 4–5 mm. This study aims to evaluate the Shear bond strength, Microleakage and Fracture resisitance of Bulk-fill composite placed using Injection molded technique and Bulk-fill technique in Clark's Class II cavity.

Hakan et al. found that the shear bond strength of Bulk-fill resin composite was comparable to that achieved via conventional resin based composites. Hence, Bulk-fill composites represented a reliable alternative to conventional composites. This was of potential benefit to dentists as using bulk-fill composites were simpler than conventional composites and required less working time.[12] Marginal gap formation was the end product of a number of clinical factors. Poor placement techniques and inadequate curing lead to such discrepancies. Furnes et al. examined the effects of composite type (bulk-fill/conventional) and placement (4-mm bulk/ 2-mm increments) on internal marginal adaptation of Class I preparations and concluded that the bulk-fill composite could be placed into a preparation having a high C-factor design and still exhibit little polymerization shrinkage stress, while maintaining a high degree of cure throughout and consequently minimize internal and external marginal gap

formation, compared to conventional incrementally placed composites.[13]

Several laboratory results concluded that preheating resin composites lead to better marginal adaptation and lowered the total gap area. As the temperature arose, the flow capacity of the resin improved, resulting in better adaptability to the walls of the cavity.[14] This was an important finding, from a clinical point of view, since perfect sealing was crucial for restoration longevity. [15] It can be expected that better marginal adaptation of preheated resins would be associated with reduced microleakage. Regarding the bond strength of composite resins, studies showed that preheating led to an increase in microhardness. [16] This can be explained by the higher rate of monomer conversion and the development of a highly cross-linked network. Contrary to these results, two studies have shown that temperature increase had no significant interference in microhardness values. [17]

Many studies showed that the Clark's Cavity preparation had better compressive bond strength than a conventional box shaped Class II cavity preparation. The reason for this could be that beveled restorations exhibited better fracture resistance and less gap formation. Beveled margins provided a series of advantages, such as removal of the non-prismatic enamel surface, increased surface energy and enhanced surface area of enamel, thereby improving adhesion and marginal sealing as well as provide a better esthetic result for the restoration. The only disadvantage of a bevel was the additional removal of sound enamel structure. [18]

In the present study, Class II cavities with Clark's configuration was prepared on the mesial surfaces of selected Premolars mounted on acrylic blocks. A Polyester matrix band was used as a matrix around the tooth. Cavities were etched with 37% phosphoric acid for 20 seconds and rinsed with water and blot dried. Bonding agent was applied to the dentin surface.

In Group 1 (Injection molded technique) flowable composite was injected into the cavity filling approximately 1/3rd of it. Preheated Bulk-fill composite (at 65 degree Celsius) was injected with a composite gun into the pool of flowable composite displacing most of the flowable composite. Excess composite was removed and a 3 point curing of 20 seconds each was done.

In Group 2 (Bulk-fill technique) the composite was placed in a bulk of 4 mm and cured for 40 sec. All Specimens were subjected to thermo-cycling for 1500 cycles between 5-55 degree Celsius.

Groups 1a and 2a were subjected to shear bond strength testing using Universal Testing Machine. Groups 1b and 2b were immersed in 0.5% methylene blue dye for 24 h, rinsed under running water to remove the dye, and dried at room temperature and evaluated with a stereomicroscope at 50x magnification. Groups 1c and 2c were subjected to fracture resistance testing using Universal Testing Machine

Statistical Analysis was carried out between all the Groups.

As per the analysis, the shear bond strength and fracture resistance was found to be higher in Group 1 than in Group 2. With the help of modified saucer shaped Class II cavity and preheated Bulk-fill resin composite, the teeth could withstand high shear stress. However, in the case of microleakage, both Group 1 and Group 2 showed comparable results.

Hence within the limitation of the study it can be assumed that, teeth restored with Bulk-fill resin composite using Injection molded technique has higher shear bond strength, lower microleakage and higher fracture resistance when compared with teeth restored with Bulk-fill technique.

CONCLUSION

Thus, from this study, we can conclude that Clark's Class II cavity restored with Bulk-fill composite using Injection molded technique showed higher shear bond strength, lower microleakage and higher fracture resistance when compared with that of Clark's Class II cavity restored with Bulk-fill composite using Bulk-fill technique. This would enable dentists to use Bulk fill Composite resins with Injection molded technique with shorter working time and with better properties.

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***Publication Type**: CASE REPORT*

STABILITY FROM SIMPLICITY: A WIRE - BASED IMPRESSION TECHNIQUE FOR THE MANAGEMENT OF RESORBED MANDIBULAR RIDGES

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Abstract

Severely resorbed mandibular ridges present a significant challenge during complete denture fabrication due to compromised support, retention, and stability. Conventional impression techniques may not accurately record the denture-bearing tissues in such cases, resulting in unstable prostheses and patient discomfort. This case report describes a modified wire-based secondary impression technique used in the prosthodontic rehabilitation of a 75-year-old male patient with a severely resorbed mandibular ridge. A special tray framework fabricated using 19-gauge stainless steel wire and stabilized with cold-cure acrylic resin was utilized during impression making. Polyvinyl siloxane impression material was loaded onto the wire framework, and functional border movements were performed to accurately record the denture-bearing area and achieve an effective border seal. The technique provided improved impression control, enhanced denture retention, and satisfactory patient comfort. This simple and cost-effective approach may be considered a useful alternative in the management of challenging mandibular ridge resorption cases.

Keywords: Resorbed mandibular ridge; Complete denture; Secondary impression; Wire-based impression technique; Atrophic mandible; Denture stability

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INTRODUCTION

Resorbed ridges are frequently encountered in elderly patients and present a significant challenge in the fabrication of stable complete dentures. The severely atrophic mandible offers limited resistance to masticatory forces due to the reduced residual ridge support. In addition, muscle attachments located close to the crest of the ridge increase the likelihood of denture displacement[1]. Therefore, obtaining an accurate impression is essential for achieving denture stability and ensuring patient comfort and functional efficiency[2].

Accurate impression making plays a critical role in the success of complete denture therapy. Conventional impression techniques may inadequately record flabby or highly resorbed tissues and can lead to overextension or uneven pressure distribution[3]. Therefore, modified impression techniques are often required to achieve optimal tissue recording and denture adaptation.

Various techniques have been proposed for recording atrophic mandibular ridges, including selective pressure impressions, admixed techniques, functional impressions, and neutral zone approaches[4]. The present case report describes a wire-based secondary impression technique used in a severely resorbed mandibular ridge to enhance impression accuracy and improve denture stability.

CASE REPORT

A 75-year-old male patient reported to the Department of Prosthodontics with a chief complaint of loose and unstable lower dentures, resulting in difficulty during mastication and speech. The patient had been edentulous since 11 years and had previously worn complete dentures with unsatisfactory retention.

Extraoral examination revealed reduced lower facial height and sunken cheeks associated with complete edentulism. Intraoral examination showed a severely resorbed mandibular residual ridge with reduced height and width. The mandibular ridge was flat with minimal attached mucosa and increased muscle activity near the denture-bearing area[5]. The maxillary ridge exhibited comparatively adequate support.
Based on the clinical findings, fabrication of a new complete denture using a modified wire-based secondary impression technique was planned.

Clinical Procedure

- **Preliminary Impression**

Primary impressions of the mandibular arches were made using irreversible hydrocolloid impression material in stock trays. Diagnostic casts were obtained using dental plaster. (Fig.1)

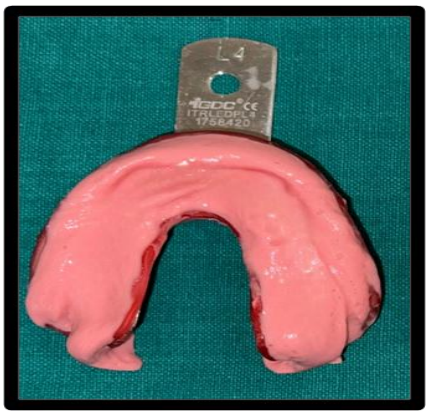

Fig.1 Primary impression

- **Custom Tray Fabrication**

On the primary cast, a special tray framework was fabricated using 19-gauge stainless steel wire (SS Smith). The orthodontic wire was contoured and looped with a universal plier, extending from one retromolar pad region to the other. The tray handle was fabricated using the same wire (Fig 2).

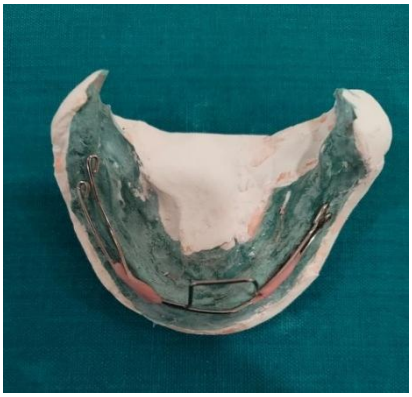

Fig 2: Special tray fabricated in primary cast

To stabilize the wire framework, cold-cure acrylic resin was adapted in the canine–premolar regions. The special tray was checked intraorally (Fig3).

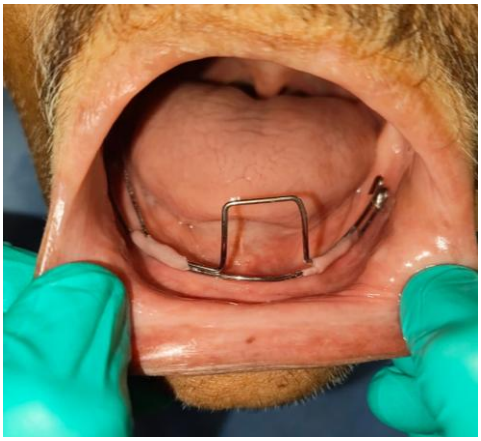

Fig 3: Intraoral try in of special tray

- **Secondary impression**

Polyvinyl siloxane impression material (Zetaplus, Zhermack, Italy) was mixed uniformly with the catalyst and base[2]. The mixed impression material was then loaded onto the wire framework. The impression was made while guiding the patient through all functional border movements to accurately record the denture-bearing area and achieve an effective border seal (Fig 4).

Fig 4: Impression using putty material

Immediately after completing the border molding, the putty was relieved with a flame-shaped carbide bur to make room for the final impression material. Zinc oxide eugenol impression material was used for the final impressions all the functional movements were done to accurately record the borders (Fig 5). The master cast was poured with die stone (Fig 6).
Registration of jaw relationships was performed after fabrication of the record blocks, and then the try-in resulted in a denture made of heat-cured PMMA that was processed by compression molding. The obtained denture showed better fit and stability.

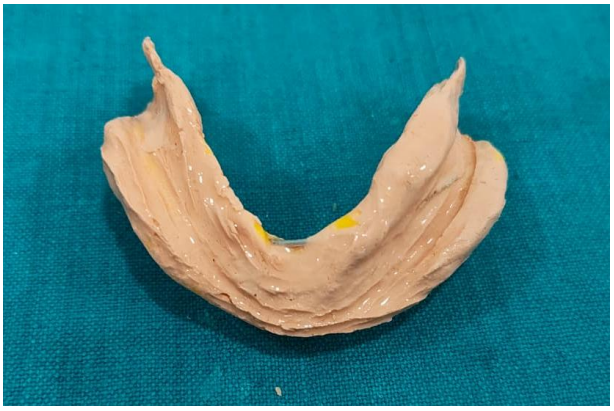

Fig 5: Final impression

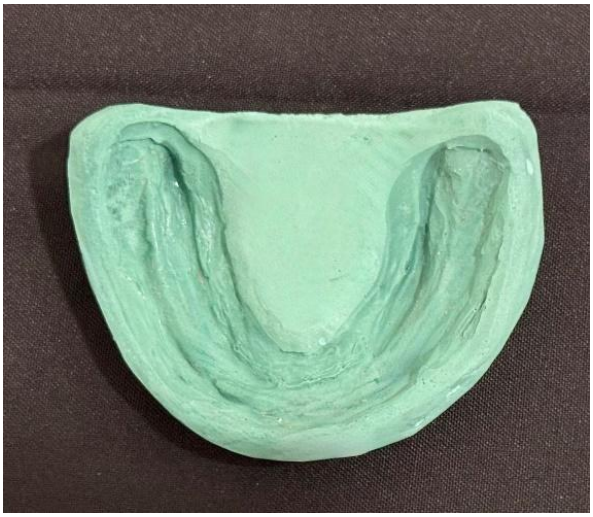

Fig 6: Master Cast

DISCUSSION

Mandibular ridge resorption significantly affects the prognosis of complete dentures. Reduced supporting tissues often result in instability, soreness, and compromised patient satisfaction[4]. Impression procedures therefore become critically important in preserving tissue health and maximizing denture function.

The present case utilized a wire-based secondary impression technique to improve control over border molding and impression material adaptation.

The wire acted as a guide and support during the impression procedure, enabling better manipulation in areas of compromised ridge anatomy. This approach minimized tissue displacement and enhanced functional recording of the denture-bearing area.

Compared to conventional techniques, the described method is simple, economical, and easy to perform in routine clinical practice. It does not require sophisticated armamentarium and can be customized according to the clinical condition of the patient.

Accurate recording of muscle attachments and functional sulcus depth is essential in atrophic mandibular cases[2]. The wire-supported approach assisted in achieving stable borders and improved impression accuracy, which contributed to enhanced denture retention and patient comfort.

Long-term follow-up and further clinical studies are required to evaluate the effectiveness and reproducibility of this technique in a larger population.

CONCLUSION

Management of severely resorbed mandibular ridges continues to be a major challenge in prosthodontics. Retention, stability, and support are the three characteristics that make full dentures successful. Because of physical restrictions, mandibular dentures might be more difficult to use[6]. The modified wire-based secondary impression technique presented in this case report themed to be a simple, economical, and clinically effective method for recording an atrophic mandibular ridge. The technique provided better control during impression making and contributed to improved denture stability and patient comfort. Compared to conventional impression methods, wire-based impressions demonstrated enhanced retention in mandibular dentures, making them a more advantageous alternative in such challenging cases[1]. Therefore, this technique may serve as a valuable option in the prosthodontic rehabilitation of patients with severe mandibular ridge resorption.

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Publication Type: *Case Report*

MANAGEMENT OF ECTOPIC THIRD MOLAR AND ASSOCIATED DENTIGEROUS CYST IN MAXILLARY SINUS: A CASE REPORT

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Abstract

Ectopic eruption of teeth in areas outside the dental arch is a rare occurrence. When maxillary teeth erupt into the maxillary sinus, they can produce symptoms affecting the sinonasal or ophthalmic regions. Additionally, an impacted tooth that remains untreated has a higher likelihood of developing into a cyst or tumor. Among odontogenic cysts, dentigerous cysts are the most common developmental type, often associated with the crowns of impacted, embedded, or unerupted teeth. This paper presents a case report and discusses the management of a patient with an impacted third molar accompanied by a cystic lesion involving the maxillary sinus.

Objective : To describe the management approach for impacted maxillary molars associated with cystic lesions involving the maxillary sinus.

Case report : The report details a patient presenting with an impacted right upper third molar and a cystic lesion involving the right maxillary sinus.

Keywords: Ectopic tooth, Impacted third molar, Maxillary sinus, Dentigerous cyst

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INTRODUCTION

Ectopic tooth eruption in non-dental areas is rare, with reported cases in the nasal cavity, nasal septum, chin, maxillary sinus, mandibular bone, condyle, coronoid process, palate, orbital cavity, and ovarian teratomas.[4,6,16] Ectopic maxillary teeth within the sinus can lead to sinusitis or ophthalmic symptoms, with third molars being the most commonly involved. Usually patients with such condition show sinonasal symptoms such as headache, facial pain, swelling, nasal obstruction, nasal discharge, epiphora, rhinorrhea, hyposmia, and orbital proptosis.[4]

The most prevalent type of developmental odontogenic cysts has to be a dentigerous cyst, typically forming around the crown of impacted, unerupted, or embedded teeth, in cases of complex odontomas and extra (supernumerary) teeth. Around 70% of the lesions occur in the mandible.[2] It is uncommon to have dentigerous cysts with an ectopic tooth in the maxillary sinus, with only 20 reported cases since 1980, which includes three cases reported by Buyukkurt et al., who took into account literature from the year 1980 to 2009 on this matter.[3]

CASE REPORT

An 18-year-old female presented with pain and pus discharge in the upper right back tooth region. When examined extraorally, it revealed a diffuse, soft, and tender swelling in close proximity to the right maxillary sinus. Intraoral examination showed a missing upper right third molar, with pus discharge originating from the distal aspect of upper right second molar along with localised pain.

Radiographic evaluation through an orthopantomogram (OPG) revealed an impacted upper right third molar located above the right second molar, showing normal morphology but incomplete root formation. A CT scan was able to reveal a large, expansile cystic lesion present in the right maxilla, protruding into the right maxillary sinus, with an unerupted third molar projecting into the cyst lumen, suggesting a dentigerous cyst. The cyst nearly filled the sinus, causing complete opacification. Dehiscence of the bony wall was noted in the floor of the alveolar process, with air loculi inside the cyst. Additionally, mild mucosal thickening was present in the left

maxillary sinus, along with a mild rightward deviation of the nasal septum, with a nasal septal angle of 8.5°. Figures 1 to 5 show the above mentioned radiographic findings and surgical procedures.

The patient, experiencing pain and associated pus discharge, underwent surgical intervention for the removal of the tooth along with the cyst, including the extraction of the second molar in that region. The surgical procedure included the elevation of a muco-periosteal flap, and the creation of a bony window posterior to the first molar region. The impacted tooth was carefully removed along with complete cystic enucleation under general anaesthesia.

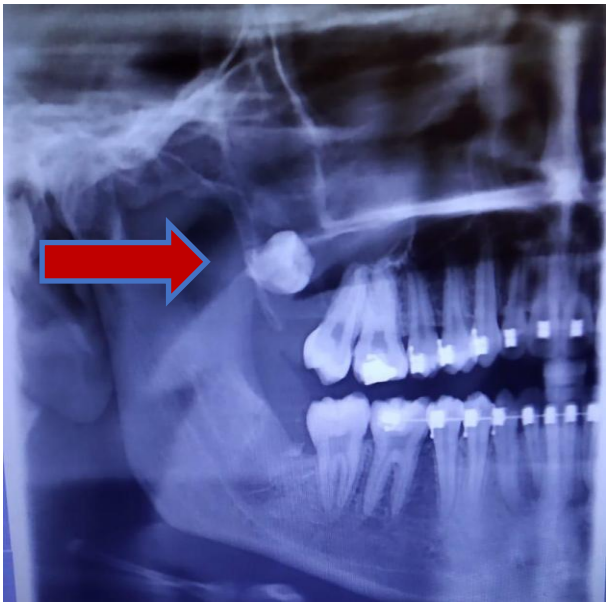

Fig 1 - OPG showing impacted upper right third molar (red arrow)

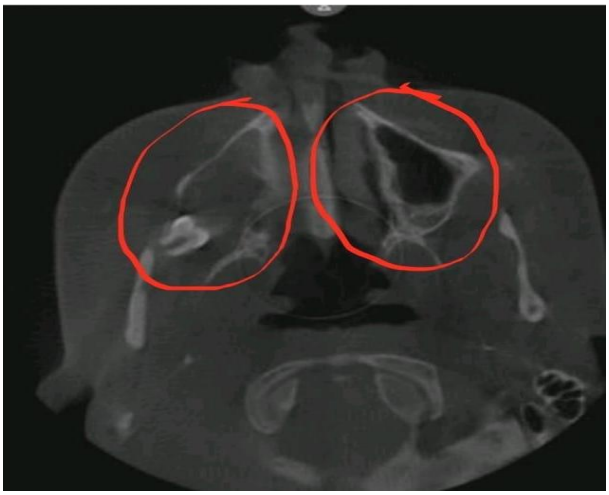

Fig 2-Ectopic maxillary third molar in the floor of the maxillary sinus. Radiopacity involving entire right maxillary antrum showing cyst in association with un erupted tooth (possibly dentigerous cyst)- Technique: CT Scan (axial plane)

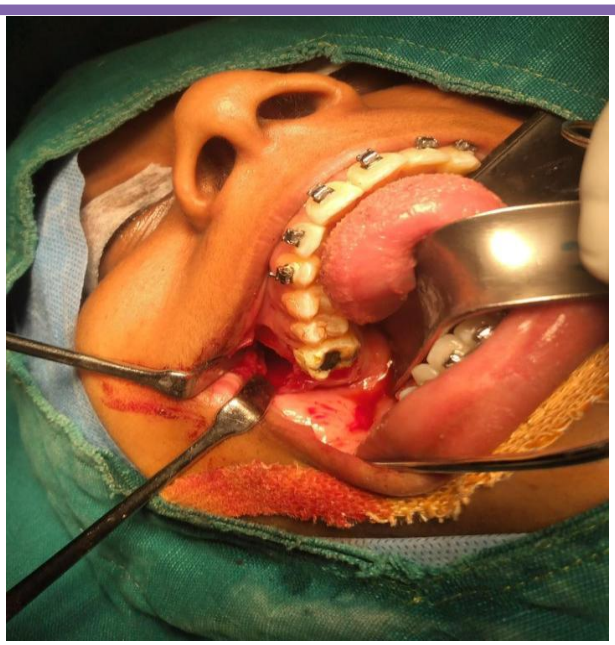

Fig 3 - Procedure of removal of associated tooth and cyst enucleation under general anaesthesia in the right maxillary molar teeth region

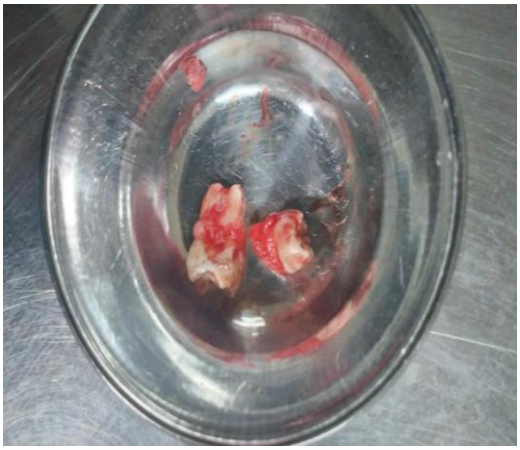

Fig 4 - Extracted maxillary second molar and impacted third molar

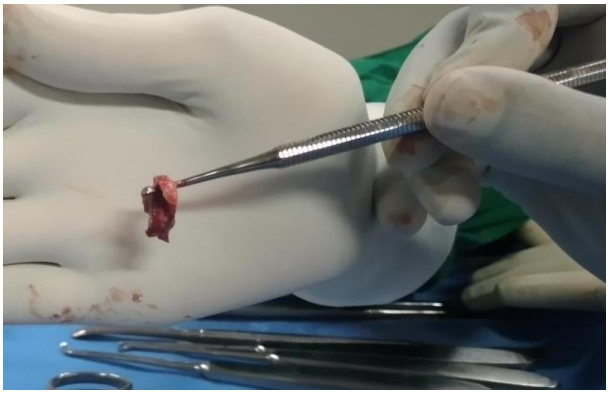

Fig 5 - Enucleated cystic remnants from right maxillary antrum

DISCUSSION

Ectopic eruption can occur due to various etiological factors or remain idiopathic. One possible cause is a disturbance in tooth development during odontogenesis, where abnormal communications of the oral epithelium and mesenchymal tissue lead to ectopic tooth formation and eruption.[12] Another contributing factor is pathological processes, such as changes in the position of tooth buds due to expansile dentigerous cysts,[1] which was also the etiologic factor in this case.[8] Additionally, iatrogenic activity can play a role, particularly at the time of extraction of a third molar, where it can be displaced to the maxillary antrum by mistake. Bonder et al. described a case in which a 40-year-old female patient's upper right third molar was inadvertently moved into the maxillary antrum during extraction.

Third molars are known to be the most commonly seen tooth erupting in the maxillary sinus. This condition is often associated with sinonasal symptoms and can lead to recurrent sinusitis, swelling, nasal obstruction, and headaches. However, some cases may remain asymptomatic. In the case being discussed, there was an expansile cystic lesion occupying the right maxillary sinus and an ectopic maxillary tooth in the maxillary sinus floor. The patient exhibited symptoms such as pain and pus discharge, with involvement of the alveolar process. Ectopic teeth have previously been discovered in the posterior region, medial wall, and other locations within the maxillary sinus in similar cases that have been documented in the literature.[6,8]

Radiographic findings of ectopic tooth eruption and associated cystic lesions of the associated sinus can be achieved using axial and coronal sections of computed tomography (CT). CT scans accurately determine the location of the tooth in relation to the sinus walls and any associated lesions. Additionally, CT imaging helps differentiate between intra-antral and extra-antral lesions, aiding in the selection of an appropriate treatment plan. Cone-beam computed tomography (CBCT) offers a three-dimensional evaluation of the sinus with a lower radiation dose than a conventional CT scan, making it a valuable alternative for diagnosis and treatment planning.

Dentigerous cysts typically appear in individuals that are middle aged and show a male predominance, with a male-to-female ratio of 1.84:1.[2] These cysts progress slowly and may remain undetected for years. When they invade the maxillary sinus, symptoms develop gradually and can include headaches, sinus obstruction and teary eyes due to nasolacrimal duct obstruction, recurrent sinusitis, purulent rhinorrhea, orbital floor elevation, and even fractures.(1) In some cases, the lesion can extend to the orbital floor, causing diplopia and, in severe instances, blindness.

Radiographically, dentigerous cysts are viewed as an unilocular radiolucent lesions of different sizes with well-defined sclerotic borders associated with the crown portion of an unerupted tooth.[14] CT imaging provides superior visualisation of bony structures, allowing for precise assessment of the lesion's size and extent.[1] Furthermore, CT scans are crucial in differentiating maxillary lesions of antral and extra-antral origins.[13]

Foreign bodies, infections such as syphilis, tuberculosis, or fungal infections with calcifications, as well as lesions like hemangioma, osteoma, osteosarcoma, enchondroma, and calcified polyps, should be taken to consideration while coming to the DD of an ectopic tooth.[6] Similarly, the DD of a dentigerous cyst must include unicystic ameloblastoma, AOT, calcifying epithelial odontogenic tumour , ameloblastic fibro-odontoma ,ameloblastic fibroma, and OKC.[1]

Unicystic ameloblastoma typically occurs in individuals below the age of 40 and is seen to affect the posterior mandible with the crown of an unerupted tooth being associated.[1] AOT is more frequent found in individuals whom are in their early to late 20s, with a higher prevalence in females, and is primarily located in the anterior maxilla. CEOT is a rare tumour that generally appears between the third and fifth decades of life, often in the posterior mandible. Ameloblastic fibroma is quite uncommon and predominantly found in the posterior mandible, with 3/4th of the cases found in association with an unerupted tooth. Ameloblastic fibro-odontoma, although occurring in the maxilla, rarely presents within the maxillary sinus. OKC can present at any age, and is most frequently found in the ascending ramus of the mandible, with almost 25% to 40% of the cases associated with an unerupted tooth.[1]

The preferred treatment for a lesion, such as the one described in this article, is enucleation and extraction of the associated tooth. Typically, the Caldwell-Luc procedure is preferred for a cyst involving the maxillary sinus.[5,15] To minimize the extent of the defect, initial marsupialization, which is then followed by enucleation and then extraction. Alternatively, an endoscopic approach can be employed, offering the advantage of reduced operative and post-operative complications.[3]

CONCLUSION

As conclusion of the present case, the chance of an ectopic tooth in the maxillary sinus and an associated dentigerous cyst associated with it is a rare. It may be asymptomatic at the beginning ages but later on it can progress to form severe complications, but require advanced diagnostic methods. Proper diagnosis and treatment planning is must in this type of cases which enhance the prognosis.

FOOTNOTES

Source of support: nil
Conflict of interest: None declared

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***Publication Type**: CASE REPORT*

ROOT MORPHOLOGICAL VARIATIONS IN MANDIBULAR THIRD MOLARS: A CBCT-BASED CASE ILLUSTRATION AND LITERATURE CORRELATION

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Abstract

Objective: To assess and record the root morphological variances of mandibular third molars, emphasizing their diversity using Cone Beam Computed Tomography (CBCT).

Study Design: We examined root number, form, curvature, and anatomical correlations in two CBCT cases of mandibular third molar impactions.

Results: Root morphology showed significant variation in both cases. One case presented four roots with mesial root dilaceration, while the other showed mesial and distal roots with bifurcation at the apical third. Different studies indicate two-rooted third molars as the most common (85.5%), with a notable presence of dilaceration (44%). Morphological variability was observed to be greater in impacted teeth and closely associated with neuroanatomical structures such as the mandibular canal and lingual cortex.

Conclusion: There is a great deal of morphological variation in mandibular third molars, particularly in impacted forms. A valuable technique for precisely describing root topologies and understanding the intricacy of third molar anatomy is CBCT imaging.

Keywords: Mandibular third molars, Root morphology, CBCT, Dilaceration

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INTRODUCTION

The mandibular third molar is known for its unpredictable developmental pattern and anatomical variability. Root morphology of these teeth is remarkably inconsistent, ranging from single to multiple roots with variable degrees of fusion, curvature, and dilaceration. These morphological variations are clinically relevant, particularly in diagnosis, treatment planning, and academic research. Studies have reported that the third molar exhibits the highest degree of morphological variation in human dentition. Bokindo et al. (2017) reported that 85.5% of mandibular third molars possess two roots, while dilaceration is observed in 44% of cases.[1] Furthermore, root morphology tends to be more complex in impacted third molars, often with closer proximity to anatomical structures like the mandibular canal. This article presents CBCT-based case illustrations of mandibular third molars to highlight the variability in root morphology and align these findings with established data in the literature.

MATERIALS AND METHODS:

Two cases were selected from the Department of Oral Medicine & Radiology, St. Gregorios Dental College, Kothamangalam. CBCT scans were obtained using the Newtom Go system with a 10x10 cm FOV and 0.15 mm voxel size. Reconstruction was performed using NNT software.

The two cases involved:

1. Patient 1: 20-year-old male
2. Patient 2: 26-year-old male

CBCT Case Evaluation:

Both patients presented with mesioangular impaction of mandibular third molars (tooth 38). The root morphology was assessed in axial, coronal, sagittal, and 3D views. Particular attention was paid to the number of roots, dilaceration, bifurcation, and their spatial relationship to the mandibular nerve and lingual cortex.

These findings were consistent with those of Bokindo et al., who noted a negative mean distance (-1.5 mm) between impacted molar roots and the mandibular canal.[1]

Root Morphology: Literature Synthesis

Several studies have documented the frequency and types of root morphologies observed in mandibular third molars:

Bokindo et al. (2017) reported that most third molars had two roots (85.5%), followed by one root (12.1%) and three roots (0.3%). Occurrence of dilacerations were observed in 44% of teeth, with closer proximity to the mandibular canal noted in impacted versus non-impacted teeth. Impactions were most frequently mesioangular (21.9%).[1]

Mohammadi et al. (2015) highlighted that mandibular third molars frequently have two roots — a mesial and distal — which often merge. Common canal configurations included fused roots and C-shaped canals, with significant endodontic implications.[2]

Park et al. (2013), in a Korean population using CBCT, observed that 56.5% had two roots, while 37.9% had one root. A small percentage (5.6%) showed three roots. 80.5% of subjects had symmetrical morphology on both sides. No gender-based or side-based variations were statistically significant.[3]

Priyank et al. (2023) conducted a CBCT-based study in a Central Indian population. They found that 95.3% of mandibular third molars had two roots, 1.5% had three roots, and 0.4% had five roots. The most common canal configuration was Type II (67.0%) on the mesial root and Type I (79.2%) on the distal root, based on Vertucci's classification. C-shaped canals were identified in 21 out of 277 samples.[4]

Table 1: Root Morphological Variations in Mandibular Third Molars (Bokindo et al., 2017)[1]

Root Characteristic	Prevalence (%)	Remarks
Two roots	85.5%	Most common configuration
One root	12.1%	May appear conical or broad
Three roots	0.3%	Very rare
Partially fused roots	2.4%	Can mimic single-rooted appearance radiographically
Dilacerated roots	44%	Often seen in impacted teeth; adds complexity
Mean root-to-mandibular canal distance	-0.5 mm	Closer in impacted teeth (-1.5 mm) vs. non-impacted (-0.2 mm)
Side variation	—	Greater nerve proximity on left side reported

RESULTS

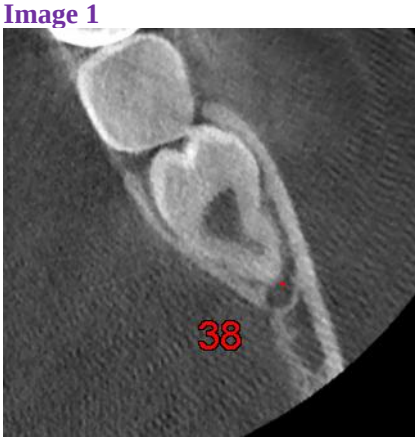
Case 1:

Mesioangular impaction of 38.

- It has a total of four roots.
- The mesial root shows dilaceration.
- Close proximity to both the mandibular nerve and the lingual cortex.
- Lingual placement of root apices

The axial image shows mesioangularly impacted 38. The root apex is placed close to the mandibular nerve. The tooth is placed close to the lingual cortex. (Image 1)

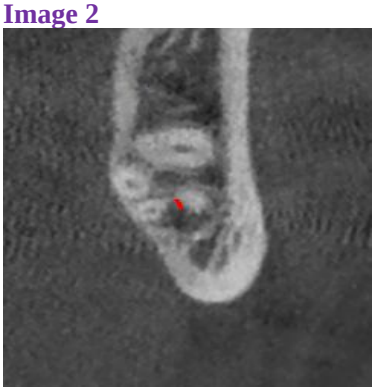
Image 1



AXIAL VIEW- 38

The root apex is placed close to the lingual cortex**.** **Number of roots -4 in number.** (Image 2).

Image 2



CORONAL VIEW-38

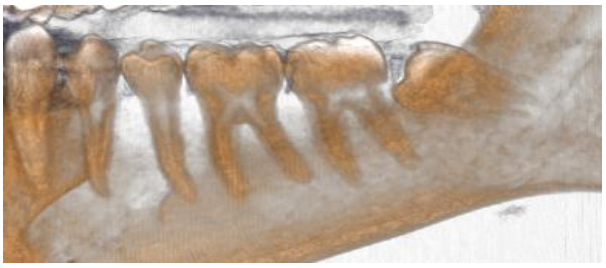
Case 2

Mesioangular of 38.

- Mesial and distal roots with apical bifurcation.
- The mandibular nerve passes between mesial and distal roots.
- Lingual cortex proximity noted.

3D reconstructed image shows mesio angular impaction of 38. (Image 3)

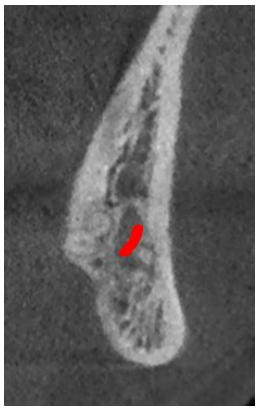
Image 3

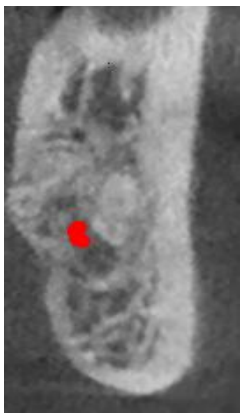


3D reconstructed image shows mesio angular impaction of 38

The mesial and distal root divide into two at apical one-third. (Image 4).

Image 4





CORONAL VIEW – 38

DISCUSSION

The root morphology of mandibular third molars is a subject of considerable anatomical variability, which has been clearly demonstrated in the CBCT case evaluations discussed herein. Despite both cases involving mesioangular impactions, a commonly encountered angulation in clinical practice, the internal anatomical configurations differed markedly, emphasizing the unpredictability associated with these teeth.

In Case 1, the mandibular third molar exhibited a rare four-rooted configuration with pronounced dilaceration. In contrast, Case 2 revealed a bifurcation at the apical third, accompanied by an intriguing finding—the mandibular nerve traversing between the roots. Such neuroanatomical relationships, while challenging to appreciate on conventional 2D radiographs, were clearly visualized using CBCT imaging, reiterating its indispensable value in preoperative planning and risk assessment.

These observations are in strong alignment with the findings from Bokindo et al., who reported:

A predominant occurrence of two-rooted third molars (85.5%). A notable 44% prevalence of root dilacerations. Increased morphological complexity in impacted versus non-impacted third molars.[1]

CBCT emerges as the imaging modality of choice in such evaluations, as it allows for high-resolution, three-dimensional visualization of the relationship to vital structures like the inferior alveolar canal.

These parameters are particularly critical when dealing with impacted third molars, where the surgical or endodontic approach must be meticulously planned to avoid complications such as nerve injury, root fracture, or missed canals during root canal therapy.[5]

The findings from Priyank et al. (2023) further support this need for advanced imaging, as their CBCT-based study in a Central Indian population revealed that 95.3% of mandibular third molars had two roots, 1.5% had three roots. Rare instances (0.4%) exhibited five roots. There is a significant presence of Type II Vertucci canal configuration in the mesial roots and Type I in the distal roots. C-shaped canals in 21 teeth, indicating complex root morphology. [4]

These findings align well with the C-shaped configuration observed in Case 2 in the current report, again stressing the diversity and complexity of third molar root canal systems.

Additionally, the study by Hadziabdic et al. (2023) sheds light on the limitations of conventional 2D radiography (like OPG), as they observed significantly more fused roots upon clinical extraction compared to radiographic evaluation. Their data further supports that mandibular third molars commonly present with fused roots (37.39%), five-cuspid crowns, and vertical positioning—trends that were seen across the CBCT cases reported here.[6]

Furthermore, the close proximity of the roots to the mandibular canal, as evident in both cases presented, confirms previous conclusions that impacted mandibular third molars are more likely to exhibit intimate anatomical relationships with neurovascular structures, thereby increasing the risk during surgical extractions and necessitate careful evaluation using CBCT. [7]

These findings echo Mohammadi et al. (2015), who highlighted the importance of understanding root configurations, including fusion, dilaceration, C-shaped canals, and auto transplantation considerations, in third molars to ensure treatment success.[2]

Lastly, Park et al. (2013) emphasized the symmetry in root morphology in bilateral third molars (noted in 80.5% of patients) and the predominance of two-rooted teeth (56.5%). However, this does not rule out the frequent presence of anomalous configurations, particularly in impacted molars, further justifying individualized, image-guided evaluations.[3]

CONCLUSION

Mandibular third molars are characterized by substantial anatomical diversity, especially in root number, shape, and curvature. Such variations are more frequently observed in impacted teeth. CBCT imaging enables detailed evaluation of these complexities, facilitating accurate documentation of dental anatomy for academic, clinical, and research applications.

Future studies with larger sample sizes and population-specific data may help establish more definitive morphological patterns and clinical correlations.

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Publication Type: *REVIEW ARTICLE*

Orthodontic Management of Patients with Attention-Deficit/Hyperactivity Disorder (ADHD): Challenges and Clinical Considerations

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Abstract

Objective

To examine the orthodontic challenges associated with Attention-Deficit/Hyperactivity Disorder (ADHD) and propose evidence-based clinical strategies for effective management.

Study design

This is a narrative review of analyzing current literature on the orthodontic manifestations and management considerations in ADHD patients, focusing on both behavioural and biological dimensions.

Results

ADHD, a prevalent neurodevelopmental disorder, is linked with a higher incidence of Class II Division 1 malocclusions, anterior open bites, and bruxism, along with increased susceptibility to dental trauma and poor oral hygiene.6 Patients often exhibit parafunctional habits and reduced treatment compliance due to impulsivity and attention deficits. Neurobiological factors, including dopaminergic dysregulation and delayed cortical maturation, further exacerbate orthodontic issues. Clinical management requires interdisciplinary coordination, customized appliance selection, and behavioural reinforcement strategies. Fixed appliances, fluoride-releasing materials, and caregiver involvement are critical for improving treatment outcomes.

Conclusion

Effective orthodontic care for ADHD patients necessitates individualized behavioural and treatment protocols. Early diagnosis, interdisciplinary collaboration, and tailored appliance design are essential to address the unique challenges posed by this population, ultimately enhancing oral health outcomes and treatment success.

Key words: ADHD, malocclusion, orthodontic management, parafunctional habits, dental trauma

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INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that typically begins in childhood, with a prevalence ranging from 1.4% to 3.0%, and it is more commonly diagnosed in boys than girls. It frequently coexists with other childhood-onset neurodevelopmental and psychiatric conditions. ADHD is considered a highly heritable and multifactorial disorder, influenced by a combination of genetic and environmental factors, though definitive causes remain unidentified. [1]

While prenatal and perinatal influences have been implicated, no specific causative factors have been confirmed. Most treatment guidelines recommend initiating care with non-pharmacological interventions before progressing to pharmacological therapy for those with more severe symptoms. Randomized controlled trials have demonstrated short-term benefits with stimulant medications and atomoxetine, although meta-analyses of non-drug therapies have not yet proven their effectiveness. Longitudinal studies reveal that individuals with ADHD face heightened risks of mental health challenges, social difficulties, and premature mortality in adulthood. [2]

The relationship between neurodevelopmental disorders and oral health has garnered increasing interest within dental research. Characterized by

symptoms of inattention, hyperactivity, and impulsivity, ADHD introduces unique challenges to orthodontic practice.

Patients with ADHD often present with increased rates of parafunctional habits, delayed dental development, and poor adherence to treatment, creating a distinctive orthodontic profile that demands tailored management approaches.[3] This article aims to characterize the common orthodontic issues observed in ADHD patients, analyze their underlying etiological factors, and propose clinical protocols for delivering effective orthodontic care.

Understanding Attention-Deficit/Hyperactivity Disorder from Childhood to Adulthood

Psychiatric Comorbidity

Epidemiological research over the past decade has consistently demonstrated high rates of psychiatric and learning disorders among individuals with ADHD. In both childhood and adulthood, ADHD is associated with significant comorbidity, including high rates of conduct disorder in childhood and antisocial disorder in adulthood. [4] Anxiety disorders commonly complicate the diagnosis and treatment of ADHD, with symptoms often presenting as social anxiety, generalized anxiety, or panic-like features. Moreover, individuals with ADHD are at least twice as likely to suffer from depressive disorders compared to the general population. Interestingly, longitudinal data suggest that stimulant treatment for ADHD may reduce the risk of developing anxiety and depressive disorders over time.[2]

The coexistence of bipolar disorder and ADHD has also been a subject of growing interest. Studies report that rates of ADHD among children with bipolar disorder range from 57% to 98%, whereas approximately 22% of children and adolescents with ADHD may develop bipolar disorder.[5] However, the validity of diagnosing both disorders concurrently remain controversial, given the overlapping symptoms and the distinct mood instability characteristic of bipolar disorder compared to the cognitive and hyperactive-impulsive features of ADHD. Substance use disorders are another major concern, as both retrospective and prospective studies indicate that individuals with ADHD are at an increased risk for cigarette smoking and substance abuse[2] during adolescence. Adolescents with ADHD are twice as likely to develop nicotine addiction, which subsequently elevates the risk for alcohol and drug use. ADHD individuals also tend to exhibit more severe substance dependence and prolonged addiction compared to their non-ADHD peers. Although concerns have been raised regarding the potential of stimulant medications to promote substance abuse, clinical evidence overwhelmingly suggests that appropriate stimulant therapy actually reduces the risk of future disorders. [2]

Diagnosing ADHD

ADHD can be reliably diagnosed across all age groups, although the current diagnostic criteria were initially developed for individuals up to 17 years of age, and may not fully capture adult presentations. The DSM-IV-TR outlines symptoms across two main domains: inattention and hyperactivity-impulsivity. To receive a diagnosis, symptoms must manifest before the age of seven, persist for at least six months, and cause significant functional impairment in two or more settings such as home, school, or work. ADHD is categorized into three subtypes: predominantly inattentive, predominantly hyperactive-impulsive, and combined type—the latter being the most prevalent and typically associated with more severe symptoms and comorbidity.

Diagnostic evaluations often utilize structured rating scales, such as the SNAP-IV Teacher and Parent Rating Scale, the Conners Rating Scale, and the Brown Attention-Deficit Disorder Scales, though these tools are supplementary and not a substitute for a thorough clinical assessment. [2] Diagnosing adults requires a detailed history to verify the childhood onset of symptoms and their persistence into adulthood. Tools like the Adult Self-Report Scale and Conners Adult ADHD Rating Scales assist in adult diagnosis. Clinicians must be cautious, as adult patients often underreport their childhood symptoms.

Comprehensive evaluation must include symptom assessment, functional impairment analysis, family history review, and evaluation for coexisting psychiatric conditions.

DIAGNOSIS CRITERIA FOR ADHD

The key symptoms of ADHD include frequent failure to pay close attention to detail, difficulty sustaining attention, seeming not to listen when spoken to, difficulty following through on tasks, organizational problems, reluctance to engage in sustained mental effort, frequent distractibility, and forgetfulness.

Hyperactivity and impulsivity manifest as fidgeting, leaving seats inappropriately, excessive running or climbing, difficulty playing quietly, acting as if driven by a motor, excessive talking, blurted answers, impatience while waiting turns, and frequent interruptions of others.

1. Often fails to give close attention to details in school work or other activities
2. Often has difficulty sustaining attention in tasks or

play activities
3. Often does not seem to listen when spoken to directly
4. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace
5. Often has difficulty organizing tasks or activities
6. Often avoids, dislikes, or is reluctant to engage in tasks or activities
7. Easily distracted by extraneous stimuli
8. Often forgetful in daily activities

Hyperactivity/Impulsivity

1. Often fidgets with hands or feet and squirms in seat. Often leaves seat in classroom or in other situations.
2. Often runs about or climbs excessively in situations where it is inappropriate adolescent adults may be limited to feelings of restlessness)
3. Often has difficulty playing or engaging in leisure activities quietly.
4. Often "on the go" or acts as if "driven by a motor"
5. Often talks excessively.
6. Often blurts out answers to questions before the questions have been completed.
7. Often has difficulty waiting in line or awaiting turn in games or group situations.
8. Often interrupts or intrudes on others (e.g., butts into conversations or games. [4]

Management of ADHD

ADHD is a globally prevalent, heterogeneous condition that often persists into adolescence and adulthood. It is now recognized as a chronic disorder, with about half of all affected children continuing to experience symptoms and impairment as adults.[6] The majority of individuals with ADHD also have a coexisting psychiatric disorder, such as oppositional defiant disorder, conduct disorder, anxiety, or mood disorders. These comorbidities exacerbate the academic, occupational, social, and personal impairments associated with ADHD, highlighting the necessity for early and ongoing treatment. [7]

Evidence strongly supports a neurobiological and genetic basis for ADHD, with catecholaminergic system dysfunction playing a central role. Psychosocial interventions such as educational support, structured routines, and cognitive-behavioural therapy are essential components of treatment, particularly in combination with pharmacological therapy.[8] Pharmacotherapy not only improves core ADHD symptoms but also enhances related functional impairments. Research shows similar presentation, neurobiology, and treatment response across paediatric and adult populations, reinforcing the continuity of ADHD across the lifespan. [2]

Orthodontic Manifestations in ADHD Patients

Patients with ADHD present a unique orthodontic profile characterized by a higher prevalence of specific malocclusion patterns. Class II Division 1 malocclusion is notably common, with a prevalence rate between 32% and 41%, and is strongly associated with the persistence of digit-sucking habits due to difficulties in self-regulation.[6] Anterior open bite, affecting approximately 28% to 35% of this population, is linked to habitual tongue thrusting and atypical swallowing patterns. Posterior crossbite, observed in 18% to 22% of ADHD patients, is often related to chronic mouth breathing and a consistently low tongue posture. Furthermore, these patients commonly exhibit an increased overjet exceeding 6 mm, which correlates with prolonged oral habits and a higher risk of traumatic dental injuries.

Parafunctional oral habits are significantly more frequent among individuals with ADHD. Studies indicate that patients with ADHD have a 3.2-fold higher likelihood of experiencing sleep bruxism compared to their neurotypical peers. [2] Behaviours such as nail-biting and object-chewing are reported in approximately 60% to 70% of cases, leading to incisal wear and frequent damage to orthodontic appliances. Temporomandibular joint (TMJ) dysfunction is also prevalent, with around 25% of adolescent ADHD patients undergoing orthodontic treatment exhibiting TMJ-related symptoms.

In addition to malocclusion and parafunctional habits, dental trauma and oral hygiene challenges are prominent in this population. ADHD patients have a 2.5 times greater risk of sustaining traumatic dental injuries compared to controls. Oral hygiene tends to be poorer, with higher oral hygiene index scores (OHI-S), indicative of greater plaque accumulation and gingival inflammation.[9] Moreover, medication-induced xerostomia, reported in about 45% of patients undergoing stimulant therapy, further exacerbates oral health issues by increasing susceptibility to caries and periodontal disease.

1. Malocclusion Patterns

ADHD patients exhibit a significantly higher prevalence of specific malocclusion types:

- **Class II Division 1 Malocclusion (Prevalence: 32-41%)**: Strongly associated with prolonged digit-sucking habits, which persist longer in ADHD children due to self-

regulation difficulties

- **Anterior Open Bite (28-35%)**: Related to persistent tongue thrusting and atypical swallowing patterns
- **Posterior Crossbite (18-22%)**: Linked to chronic mouth breathing and low tongue posture
- **Increased Overjet (>6mm)**: Correlates with both digit-sucking and increased risk of traumatic dental injuries

2. Parafunctional Habits and TMJ Disorders

- **Bruxism**: ADHD patients show 3.2 times higher likelihood of sleep bruxism compared to controls
- **Nail-biting and object-chewing**: Present in 60-70% of cases, contributing to incisal wear and appliance damage
- **TMJ dysfunction**: Reported in 25% of adolescent ADHD patients undergoing orthodontic treatment

3. Dental Trauma and Oral Hygiene Challenges

- **2.5 times higher incidence** of traumatic dental injuries in ADHD patients
- **Poorer oral hygiene indices** (OHI-S scores 2.1 vs 1.3 in controls)
- **Medication-related xerostomia** in 45% of patients on stimulant therapy

Etiological Considerations

The etiological factors contributing to orthodontic issues in ADHD patients are multifaceted, involving both behavioural and neurobiological components. Behavioural factors play a crucial role; impulsivity leads to increased risk-taking behaviours, significantly elevating the likelihood of dental trauma.

Sensory-seeking tendencies manifest as persistent oral habits such as chewing and sucking, which negatively impact occlusal development. Attention deficits further complicate the situation by impairing the patient's ability to maintain adequate oral hygiene and care for orthodontic appliances.

Neurobiological factors also contribute significantly to the orthodontic manifestations observed in ADHD patients. Dopaminergic dysregulation, a core neurochemical feature of ADHD, affects oral motor control, leading to dysfunctional swallowing patterns and prolonged oral habits. [7]

Additionally, delayed cortical maturation has been implicated in atypical swallowing and oral posture, which further promotes the development of malocclusions. Comorbid sleep disorders, frequently encountered in ADHD, exacerbate parafunctional activities such as bruxism, compounding the risk for TMJ disorders and occlusal anomalies.

Behavioural Factors

- Impulsivity → Increased risk-taking behaviours and dental trauma
- Sensory-seeking → Persistent oral habits (chewing, sucking)
- Attention difficulties → Poor appliance care and oral hygiene

Neurobiological Factors

- Dopaminergic dysregulation affecting oral motor control
- Delayed cortical maturation influencing swallowing patterns
- Comorbid sleep disorders exacerbating bruxism

Clinical Management Strategies

Effective orthodontic management of patients with ADHD necessitates a multidisciplinary, patient-centered approach that addresses both the behavioural and biomechanical challenges inherent to this population. Treatment modalities encompass behaviour modification, educational counselling, pharmacological intervention, and lifestyle changes. [7]

During the pre-treatment phase, a comprehensive behavioural assessment should be undertaken to evaluate the patient's executive functioning capabilities. It is equally important to assess the level of family support and caregiver involvement, as these factors are pivotal for successful treatment adherence.

A detailed risk-benefit analysis should guide the prioritization of interceptive treatments for high-risk malocclusions, favouring phased treatment plans that include clearly defined milestones to enhance compliance and monitor progress effectively.

Management of the child with ADHD involves four broad approaches:
• Behaviour modification
• Educational (counselling)
• Pharmacological
• Lifestyle changes

Pre-Treatment Phase

1. **Comprehensive Behavioural Assessment**
    - Evaluate executive function capacity using standardized tools
    - Assess family support systems and caregiver involvement

2. **Risk-Benefit Analysis**
    - Prioritize interceptive treatments for high-risk malocclusions
    - Consider phased treatment plans with clear mileston

Behavioural Management Techniques

Behavioural management is a cornerstone of successful orthodontic treatment in ADHD patients. Strategies such as stimulus control—designating specific times for appliance checks—can enhance treatment regularity. Token economy systems, wherein patients are rewarded for maintaining appointment schedules and appliance care, have shown considerable efficacy. The use of visual schedules or treatment progression charts helps improve patient engagement and provides clear expectations.[10]

- **Stimulus control**: Designate specific appliance-check times
- **Token economies**: Reward systems for appointment adherence
- **Visual schedules**: Treatment progression charts
- **Desensitization protocols**: Gradual appliance introduction

Non-pharmacological behaviour management techniques

Non pharmacological management within the dental clinic setting are crucial. Pre-appointment preparation plays a pivotal role; children should be introduced to the dental environment prior to the initiation of treatment, reducing anxiety and enhancing cooperation. Scheduling appointments early in the morning, when patients and clinicians are less fatigued and medication effects peak, is recommended. Multiple short visits, rather than prolonged sessions, increase the likelihood of successful outcomes. Frequent breaks during appointments allow the child to release excess energy, maintaining focus during critical treatment phases. [10]

Clear, simple instructions, repeated as necessary, foster confidence and understanding. The Tell-Show-Do method, which involves explaining and demonstrating procedures before execution, has proven highly effective in managing children with ADHD. Praise and positive reinforcement should be consistently employed to encourage desirable behaviours. In cases where behavioural techniques are insufficient, protective stabilization or physical restraint may be employed judiciously to ensure patient safety and treatment efficacy. [10]

Pharmacological Behaviour Management

In certain cases where non-pharmacological behaviour management strategies prove insufficient, pharmacological sedation may be considered. However, caution must be exercised, as many children with ADHD are on stimulant medications that can antagonize the effects of sedatives. Some studies have reported failed sedations or the need for higher concentrations of sedative agents in this population, while others have successfully managed sedation without complications. [8]

Before prescribing any sedative medication, it is imperative that the dentist consults with the child's physician to understand the child's current pharmacological regimen and to anticipate potential drug interactions. Commonly used sedative drugs in dental management include demerol, promethazine, and nitrous oxide. Although general anaesthesia (GA) has not been extensively studied in ADHD patients, one prospective study comparing children with and without ADHD undergoing elective surgery indicated that induction can be significantly more challenging, and that maladaptive behaviour may increase postoperatively. Consequently, GA should be reserved for cases where no other management strategies are feasible.

Interdisciplinary Coordination

Effective management of ADHD patients within orthodontic practice requires close interdisciplinary collaboration. Consultation with the child's medical team is crucial to optimize the timing and effectiveness of ADHD pharmacotherapy in relation to dental appointments. Referrals to occupational therapists can be beneficial for addressing sensory integration issues that may complicate dental treatment, while psychological support services can aid in implementing cognitive-behavioural strategies for habit reversal and behaviour modification.

Parental involvement is paramount in maintaining oral hygiene and dietary control, as these tasks require concentration, motivation, and consistent effort—traits often impaired in children with ADHD. Anticipatory guidance should be provided to parents, equipping them with strategies to prevent and manage dental injuries, to reinforce oral hygiene routines, and to monitor dietary habits. Written instructions are especially useful, as children with ADHD are prone to forgetfulness and disorganization. Tools such as tooth-brushing charts can enhance compliance with home care protocols.

Additionally, the use of custom-fabricated occlusal

splints is recommended for managing bruxism, while medication forms should be transitioned from syrups to capsules or tablets as soon as the child can safely swallow them to minimize the risk of dental decay. Due to the elevated risk of substance use disorders in ADHD patients, careful documentation is advised, particularly when sedation or local anesthesia is administered, to anticipate and prevent potential drug interactions. [8]

Case Insights

The management of ADHD patients presents distinct challenges to the pedodontic and orthodontic teams; however, with thorough evaluation of their treatment needs and cooperative capabilities, these patients can be treated successfully. In the case example discussed, the child exhibited classical oral health issues commonly non-pharmacological management approaches. [10]

The child's ability to cooperate, likely aided by adequate medication adherence, enabled successful treatment without reliance on pharmacological methods. Episodes of non-cooperation were closely linked to lapses in medication intake, emphasizing the importance of ensuring that the child has taken prescribed medications prior to dental visits. [2]

This patient also demonstrated an increased risk for dental trauma and self-injurious behaviour, both of which are characteristic of ADHD. Additionally, he was classified as high-risk for dental caries due to a combination of poor oral hygiene practices, habitual food pouching, and medication-induced xerostomia from Risperidone use. Although children with ADHD frequently exhibit molar–incisor hypomineralization, in this case, hypoplastic premolars were noted instead. [5]

The prospect of orthodontic treatment was initially questionable given the child's compromised oral hygiene; however, with weekly plaque control measures and frequent reinforcement, significant improvements were achieved. Unlike some ADHD patients who may require general anaesthesia due to behavioural management difficulties, this child was successfully treated without it.

To improve attention spans over time, it was recommended that the child engage in activities requiring significant concentration, such as video games or structured block arrangement tasks. For younger children, substituting candies for blocks was suggested to reduce the risk of ingestion accidents.[10] This practical approach to attention training complements the broader strategy of behavioural reinforcement essential for the successful management of ADHD patients. [7]

Appliance selection must be carefully tailored to the patient's behavioural characteristics. For patients with low compliance, fixed orthodontic appliances such as conventional brackets are preferable, as they minimize reliance on patient cooperation.

In cases where high impulsivity is observed, durable appliances like lingual arches and space maintainers should be considered to reduce the risk of damage. Sensory-sensitive patients may benefit from self-ligating brackets, which offer reduced friction and enhanced comfort.

For those experiencing xerostomia due to stimulant medication, fluoride-releasing orthodontic materials can provide an added layer of caries protection. [8]

Appliance Selection Guidelines

ADHD Characteristic	Recommended Appliance	Rationale
Low compliance	Fixed appliances (e.g., conventional brackets)	Reduced dependence on patient cooperation
High impulsivity	Lingual arches, space maintainers	Minimize damage risk
Sensory sensitivity	Self-ligating brackets	Reduced friction and discomfort
Medication xerostomia	Fluoride-releasing materials	Caries prevention

CONCLUSION

ADHD presents distinctive challenges in the orthodontic setting, necessitating modifications in both treatment strategies and patient management techniques. Key success factors include the early identification of orthodontic and behavioural risk factors, the careful selection of customized appliances that accommodate behavioural traits, the implementation of intensive behavioural support programs, and the establishment of coordinated interdisciplinary care involving medical, dental, and psychological professionals.

Future research should prioritize the development of validated assessment tools to evaluate orthodontic

readiness in neurodiverse populations and investigate the long-term stability of orthodontic outcomes in ADHD patients. It is critical that dental professionals possess a thorough understanding of ADHD to enable accurate diagnosis, appropriate behaviour management, timely intervention, and proper referral when necessary, thereby promoting optimal general and oral health for these patients.

Children with ADHD have been found to present significantly higher Dental Aesthetic Index (DAI) scores, more severe dental rotations, and an increased prevalence of parafunctional oral habits compared to neurotypical controls. [2] Given these findings, there is a compelling need for the development of preventive orthodontic programs as well as tailored therapeutic strategies aimed specifically at this vulnerable population.

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