Journal of Research in Medical and Dental Science
2024, Volume 12, Issue 4, Page No: 14-24

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Maxillary Molar Intrusion Therapies

Eeshita Behl*, Isha Aggarwal, Sanjay Mittal, Merry, Pallavi Vishavkarma

Department of Orthodontics, Bhojia Dental College and Hospital, India

ABSTRACT

Introduction: Molar intrusion has always been a complicated and difficult treatment modality. Posterior teeth that are supra-erupted due to the early loss of their antagonists are commonly seen in adults that have limited or no access to dentistry during childhood and adolescence. Severely over-erupted molars or entire posterior segments pose a great challenge to the treating orthodontist. With regard to intruding posterior teeth, molar intrusion is a treatment option for patients with Anterior Open Bite (AOB); a malocclusion often characterized by the overeruption of the posterior teeth or/and under eruption of the anterior teeth.

Aim: To compile and summarize the existing and advanced molar intrusive techniques and appliances with respect to their advantages and disadvantages, and their possible clinical effectiveness.

Conclusion: We can utilize skeletal anchorage and surgically assisted techniques for efficient intrusion with limited side effects.

Key words: Molar intrusion, Over eruption, TADs

HOW TO CITE THIS ARTICLE: Eeshita Behl, Isha Aggarwal, Sanjay Mittal, et al. Maxillary Molar Intrusion Therapies. J Res Med Dent Sci, 2024, 12(4):14-24.

Corresponding author: Eeshita Behl
e-mail✉**:** ameenachanna@outlook.com.
Received: 25-March-2024, Manuscript No. jrmds-24-128812;
Editor assigned: 28-March-2024, PreQC No. jrmds-24-128812(PQ);
Reviewed: 11-April-2024, QC No. jrmds-24-128812(Q);
Revised: 16-April-2024, Manuscript No. jrmds-24-128812(R);
Published: 23-April-2024

INTRODUCTION

Supra eruption of teeth is basically over eruption of tooth due to lack of opposing force in the occlusion [1]. With time, it can worsen the occlusion leading to detrimental effects. To avoid such type of malocclusion molar intrusion is necessary which will create a proper cusp to fossa relation [2]. Molar supra eruption is mainly caused by missing antagonists and no replacement or by failure of eruption in growing patients [3]. Any situation can complicate the placement of prosthetic restorations and lead to lateral occlusal interferences. Although several authors have demonstrated the possibility of intruding a supra erupted molar, reported amounts of true intrusion have been modest.

According to Sarah Abu Arqub, et al [4], intrusion is one of the most mechanically challenging types of tooth movement. This is primarily due to the greater root volume of these teeth. It has been described as the apical movement of the geometric centre of the root with respect to a plane perpendicular to the long axis of the tooth. The mechanical stresses are often increased with intrusion at the root apex, which might increase the risk of root resorption with this specific type of tooth movement. The mechanics used in the majority of these years relied heavily on patient compliance. Several cases reports have been published using different intrusive mechanical approaches. However, more organized clinical trials are still needed to evaluate the amount of intrusion obtained from using different techniques.

It has been reported that 82% of subjects presented with supra-erupted maxillary molars would require adjunctive orthodontic restorative and/or endodontic interventions prior to prosthetic replacement for the opposing teeth to correct inter-occlusal space deficiency [5]. Therefore, orthodontic intrusion is a clinically desired treatment option for supraerupted teeth. Posterior teeth intrusion

is one of the treatment strategies for treating anterior open bites [6]. Treatment approaches for open bite patients differ when dealing with adults and growing patients. In growing patients, the vertical forces applied against the molars serve not only to intrude the molars but simply to control their vertical eruption. In adults or non-growing patients with the absence of vertical compensation of ramus growth, the true intrusion of molar teeth is needed to let the mandible auto rotate and subsequently close the open bite anteriorly. According to jaw geometry, 1mm of intrusion posteriorly would result in about 2mm of anterior open bite closure. In the past two decades, the clear aligner has been increasingly used owing to its esthetic and transparent features [7]. Aligners are effective in teeth intrusion, as they cover the entire dentition, exhibiting the "block effect" on the molars. Since the introduction of Temporary Skeletal Anchorage Devices (TSADs) into orthodontics, the range of tooth movement has expanded [8]. Their use for the intrusion of posterior teeth has been revolutionary in enabling the nonsurgical correction of Anterior Open Bite (AOB) while simultaneously reducing the anterior facial height. The amount of force used for molar intrusion varies significantly in the literature. The recommended force load is usually between 100 and 200 g per side for intrusion of a single molar, and between 200 to 400 g per side to intrude a maxillary posterior segment. Force exceeding 400 g is not used. There seems to be a lack of agreement regarding the timing of force application, which ranges from immediate loading to 12 weeks delay. The primary objective of this review article is to comprehensively compile and update various molar intrusion techniques published in the literature.

Molar Intrusion and Anatomical Considerations

Molar intrusion, apart from the desired clinical effect, may also have a negative influence on the tooth itself and adjacent anatomical structures. As in other types of orthodontic tooth movement, the risk of external apical root resorption should be considered. From histological studies, it is apparent that some resorption is always present as a result of orthodontic tooth movement [Figure 1]. In most cases, resorption lacunae are restored after the end of treatment, and in 3%–5% of cases, severe resorption with significant loss of root structure is found. Studies on experimental animals and humans have shown that during intrusion of multi-radicular teeth with temporary anchorage devices only clinically negligible root resorption occurs. As the root is pushed into the bone and force is concentrated on the root apex, the blood supply may also be compromised. Some changes occur in the pulp as a result; however, it has been shown that these changes are only temporary and are restored back to normal in 3 months. During intrusion, apical remodeling of the alveolar crest also occurs due to supra-alveolar trans-septal periodontal fibers.

CLASSIFICATION

Through the decades, various treatment strategies have been developed to intrude molar teeth [Table 1], ranging from non-surgical to surgical approaches. Different appliances can be used which can rely on patient's compliance.

NON-SURGICAL

These are non-invasive in nature. Risk of damage to roots and adjoining structures and soft tissue irritation is reduced in these techniques.

Compliance Appliances

These appliances need patient compliance **for bringing about the required changes in a specific duration of time.**

Figure 1: Esthetically compromised alveolar bone irregularity occurring due to incisor intrusion and retraction.

Table 1: Classification of Molar Intrusion techniques.

NON-SURGICAL		SURGICAL
Compliance appliances	1) High pull headgear	1) Corticotomy-enhanced molar intrusion
	2) High pull headgear to a splint	
	3) Vertical pull Chin cap	
	4) Posterior bite-block	
	5) Magnetic bite-block	
	6) Spring-loaded bite-block	
Non-compliance appliances	1) Temporary Anchorage Devices (TADs)	2) Osteotomy-assisted molar intrusion
	3) Rapid molar intrusion device (RMI)	
	4) Vertical holding appliance (VHA)	
	5) Clear Aligners	
	6) Multi-loop edgewise arch wire technique	
	7) Active Vertical Corrector (AVC)	

HIGH PULL HEADGEAR

It was first given by Dr. S.J. Kloehn who soldered the two outer bow and inner bow.

Appliance Design

The components of headgear consist of a face bow, force elements and extra oral anchorage straps.

A face bow is used to transfer forces to the tooth intraorally through buccal tubes.

The force elements are used to generate force. This can be done using elastics or with the help of springs.

Mechanism of Action

The force is directed carefully through the center of resistance of the upper first molar which is located at the level of buccal trifurcation area. The use of a Trans Palatal Arch (TPA) is necessary to maintain the arch width and to prevent molar rotation.

Advantages

It can be used for intrusion of the entire dental arch.

Disadvantages

The direction of the force passing above or below the center of resistance of maxillary first molar leads to undesirable extrusion of tooth by tipping the crown mesially or distally [Figure 2].

HIGH PULL HEADGEAR TO A SPLINT

This type of headgear is used for intrusion of a group of teeth and was first given by Kloehn.

Appliance Design

It has the same design as a high pull headgear but is attached to a splint covering the intended teeth and works with similar principles of high pull headgear.

Mechanism of Action

It works with similar principles of high pull headgear; however, the force is applied to a to a splint covering the specific teeth.

Advantages

Light intrusion of maxillary dentition using headgear that is attached to a full-coverage maxillary occlusal splint.

Disadvantages

There is limited research published specifically regarding this appliance [Figure 3].

VERTICAL PULL CHINCAP

The use of restraining devices to reduce mandibular prognathism was reported in the early 1800s. Cellier in France and Fox, Kingsley, and Farrar in the United States all designed appliances that resemble today's chin cup.

Appliance Design

Chin cup is an extra-oral appliance designed to exert an upward and backward force on the mandible by applying pressure to the chin, thereby preventing forward growth.

Mechanism of Action

A force of 400 g is applied per side, and the force vector passes through the anterior and inferior region of the mandibular corpus approximately 3 cm from the outer canthus of the eye.

Advantages

It can be used for molar intrusion in cases of open bites.

Disadvantages

Lingual tipping of lower incisors and crowding result following chin cup therapy [Figure 4].

Figure 2: High Pull Headgear.

Figure 3: High Pull Headgear with a splint.

Figure 4: Vertical Pull Chin cap.

POSTERIOR BITE-BLOCK

Passive acrylic posterior occlusal bite-blocks were given initially by Altuna and Woodside in 1985 and Proffit and Fields in 1986.

Appliance Design

It consists of an acrylic pad placed on the posterior teeth.

Mechanism of Action

These functional appliances hinge the mandible open by approximately 3-4 mm beyond its resting position, thereby maintaining pressure on the neuromuscular system supporting the mandible.

Advantages

Effective in controlling vertical dimension which is of benefit for patients with skeletal open bite.

Disadvantages

When intrusion of the posterior teeth is needed in adults with excess vertical face height, bite-blocks have been unsuccessful in accomplishing molar intrusion [Figure 5].

MAGNETIC BITE-BLOCK

This appliance was first introduced by Dellinger, under the name active vertical corrector.

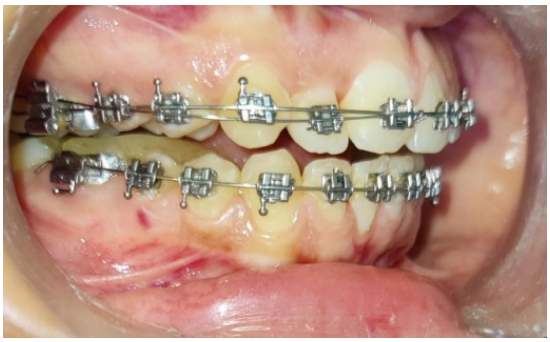

Figure 5: Posterior Bite Block.

Appliance Design

The components of this appliance are, two posterior occlusal splints, one for the upper arch, and one for the lower arch. Samarium cobalt magnets are used along with acrylic splints, on the occlusal surface of the teeth that are planned for intrusion.

Mechanism of Action

Samarium cobalt magnets are incorporated into the acrylic splints, over the occlusal region of the teeth that planned to be **intruded.** These magnetic modules are expected to generate forces between 600 and 650 g per module

Advantages

Magnetic posterior bite-blocks also have shown to produce a quick response in the dental and skeletal vertical relation.

Disadvantages

Maintaining arch width is sometimes difficult with magnetic bite-blocks [Figure 6].

SPRING-LOADED BITE-BLOCK

The design of spring-loaded bite-blocks was first described, in 1986, by Woodside and Linder-Aronson.

Appliance Design

Upper and lower bite block are connected with two helical springs.

Mechanism of Action

They are activated progressively to maintain the forces between 250 and 300g.

Advantages

Few authors have reported that it has an orthopaedic influence in treating open bite by intruding molars in growing patients.

Disadvantages

However, to this date, there is limited data regarding intrusion in adults [Figure 7].

NON-COMPLIANCE APPLIANCES

These devices do not require patient compliance for optimum results. This is a big advantage over compliance appliances as we can achieve the desired results without the need for patient co-operation.

TEMPORARY ANCHORAGE DEVICES (TADs)

Kanomi and Costa introduced the concept of Miniscrews for orthodontic anchorage. Umemori were the first to use miniplates as temporary skeletal anchorage for molar intrusion in managing the open bite malocclusion.

Mechanism of Action

Molars can be intruded approximately 2-4 mm using skeletal anchorage, with better results in the maxilla than mandible.

Appliance Design

The mechanics for molar intrusion in the buccal positioned TADs comprises of a vertical intrusive force applied directly to the molar or molars.

A buccal force from another buccal screw is combined to counteract the palatal moment. For intrusion of single molar tooth, the force could be applied from a cantilever attached directly to the Miniscrews in combination with a TPA to counteract 3rd-order side effects.

Advantages

Simple to insert, less traumatic, and more secure under optimal force loads.

Intrusion of the posterior teeth with skeletal anchorage has been shown to be stable.

Disadvantages

With TADs located in the palate, it could be difficult to obtain a vector sum that passes through the center of resistance due to the anatomy of the palatal and buccal alveolar bone [Figure 8].

Figure 6: Magnetic Bite Blocks.

RAPID MOLAR INTRUSION DEVICE (RMI)

This appliance has been first proposed by Carano and Machata.

Appliance Design

It has 2 elastic modules that are secured on the first molars with L-shaped pins. The straight terminal end attaches into a maxillary molar tube and the angulated terminal end attaches to a mandibular tube.

Mechanism of action

When the patient closes their mouth, the modules are flexed and deliver an immediate intrusive force of 800 g on each side. This force level decays to 450 g by the end of the 1st week and 250 g by the end of the second week. Because the intrusive forces on the labial side of the molars generate moments that tip the crowns buccal, the RMI appliance is always placed with TPA in upper and a lingual arch in lower.

Advantages

Intrudes the upper and lower first molars significantly in growing patients and adults.

Disadvantages

It intrudes both the upper and lower molars simultaneously [Figure 9].

VERTICAL HOLDING APPLIANCE (VHA)

Wilson first reported on the clinical advantage of using a modified trans palatal arch dubbed as the Vertical Holding Appliance (VHA).

Appliance Design

Vertical Holding Appliance is a Trans palatal Arch with an acrylic pad.

Mechanism of Action

Theoretically, pressure from the tongue reduces the eruption of maxillary permanent first molars during growth. However, it has not been clinically proven.

Advantages

During orthodontic treatment, VHA is helpful in restricting further anterior bite opening resulting from molar extrusion during leveling and alignment.

Disadvantages

Patient discomfort during chewing and swallowing [Figure 10].

CLEAR ALIGNERS

Stanford University students, Zia Chishti and Kelsey Worth, invented the world's first complete clear aligner system. It became available to orthodontists in 1999. Clear aligners showed excellent clinical vertical control of the molars.

Appliance Design

Unlike fixed appliances, the clear aligner is composed of thermoplastic materials and attachments, which provide a consistent and gentle force.

Mechanism of action

Aligners are effective in teeth intrusion, as they cover the entire dentition, exhibiting the "block effect" on the molars.

For esthetic purposes, attachments are mainly used as retention aids made of resin and bonded to the target teeth surface. They can change the direction of orthodontic forces applied to the teeth to guide them toward the target position and aid in achieving orthodontic intrusion movements.

Advantages

More esthetic and are comfortable to wear

Figure 7: Spring Loaded Bite Blocks.

Figure 8: TADs

Figure 9: Rapid Molar Intrusion Device.

Figure 10: Vertical Holding Appliance.

Disadvantages

They need to be worn for a long time during the day (almost the entire day) [Figure 11].

MULTILOOP EDGEWISE ARCH WIRE TECHNIQUE

The Multi-loop Edgewise Arch Wire (MEAW) technique was originally designed by Young H. Kim for the treatment of severe open bite patients without the surgical intervention.

Appliance Design

MEAW arches are made of 0.016″×0.022″ steel wire with an ideal arch shape, in which five L-loops are incorporated in each quadrant starting distally of the lateral teeth.

Mechanism of action

This technique uses a combination of 0.016×0.022 SS arch wires with multiple loops and heavy anterior elastics to achieve molar intrusion and incisor extrusion simultaneously, resulting in closure of anterior open bite and mainly affects the dento-alveolar region.

Advantages

It provides gentle but continual orthodontic forces for biologically advantageous tooth movement.

Disadvantages

The orthodontist needs to have a good knowledge of this method as well as good bending skills and precise execution [Figure 12].

ACTIVE VERTICAL CORRECTOR (AVC)

It was given by Dellinger; The AVC can be a fixed or removable appliance that leads to intrusion of posterior teeth in the maxilla and mandible by reciprocal forces.

Appliance Design

The appliance uses the repelling force of samarium cobalt magnets, incorporated in acrylic, for intrusion of the posteriors.

Mechanism of Action

The appliance uses the repelling force of samarium cobalt magnets, incorporated in acrylic, for intrusion of the posteriors.

Advantages

Better facial balance and esthetics than most conventional orthodontic treatment procedures.

Disadvantages

Maxillary and mandibular incisor extrusion and lingual tipping of the mandibular incisor is also seen [Figure 13].

Figure 11: clear aligner showing intrusion.

Figure 12: Multi-loop Edgewise Arch Wire Technique

Figure 13: Active Vertical Corrector.

SURGICAL

These molar intrusion techniques are surgical intervention for accelerating the rate of tooth movement with increased treatment efficiency and less chances of relapse.

CORTICOTOMY-ENHANCED MOLAR INTRUSION

LC. Bryan in 1892 was the first to report use of corticotomy as an adjuvant for malocclusion correction procedures.

Procedure

After raising a full mucoperiosteal flap, corticotomy is performed selectively for intended molar or molars to be moved. Vertical cuts were made on both mesial and distal interproximal areas starting 2-3 mm above the alveolar crest. It extends 2-3 mm past the estimated root apices, and then a horizontal corticotomy was performed connecting the interdental cuts.

Mechanism of Action

To apply an intrusive force, various methods are used. For example, an acrylic splint covering the teeth except the tooth or teeth needed to be intruded can have an intrusive force from a coil spring attached to the J-hooks in the buccal and lingual shields which passes over the occlusal surface. Intrusive forces could be applied from a magnetic - repelling acrylic splint or skeletal anchorages, such as zygomatic anchors, miniplates, or Miniscrews.

Advantages

It facilitates orthodontic tooth movement by regional acceleration phenomenon.

Disadvantages

The apical third of the first molar mesiobuccal root undergoes high stresses, which can lead to root resorption [Figure 14].

OSTEOTOMY-ASSISTED MOLAR INTRUSION

In 1880, Mac Ewen published the first book devoted entirely to osteotomy where he detailed his experience of 1800 cases with few complications.

Mechanism of Action

In a case report, where an osteotomy had been performed, intrusive force was applied from a miniplates on the zygomatic buttress in a patient with an open bite. More research is required to determine the limitations of this procedure.

Advantages

Less need for extra oral appliances

Disadvantages

High levels of initial stresses in PDL may relate to orthodontic external root resorption [Figure 15].

Stability of Molar Intrusion

Maintaining the position of intruded molars is a challenging step after orthodontic treatment of open bite malocclusion. Different factors may contribute in the relapse of open bites such as tongue size or posture, unfavorable growth patterns, orofacial musculature, respiratory problems, and dental movements. In general, the stability of open bite treatment is greater than approximately 75% [9]. Nevertheless, in growing patients, long-term post-treatment stability is unpredictable, particularly, in those

Figure 14: A miniplates was attached into the L shaped fissure formed during corticotomy.

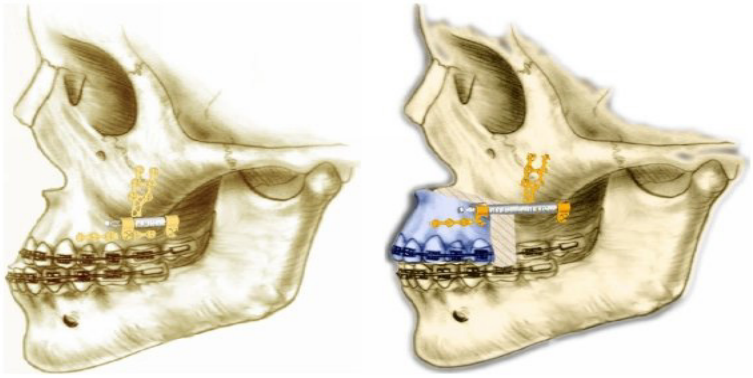

Figure 15: Intrusive force applied from miniplates on the zygomatic buttress.

having potential vertical growth pattern [10]. The use of temporary anchorage devices seems to be clinically efficient and a stable method in maxillary molar intrusion. Several authors have reported tendency of relapse ranging between 20% and 30% when using TADs for molar intrusion [11].

CONCLUSION

There is limited evidence related to the effectiveness of different appliances in achieving maxillary molar intrusion. The use of temporary anchorage devices seems to be clinically efficient in maxillary molar intrusion. Some of these appliances (such as spring loaded or magnetic posterior bite blocks) and the RMI provide posterior occlusal coverage; therefore, offer the additional advantage of intruding the mandibular molars. The mechanics for intruding the molar/molars are usually accompanied with reciprocal effects on the anchorage units. With the limitation of available strong evidence, utilizing skeletal anchorage or, to a lesser extent, performing some surgical procedures such as corticotomy, to the intended teeth could be promising in efficient movements.

REFERENCES

1. Mali SB, Handa A, Sarda A, et al. Mechanics of Molar Intrusion: A Review. 2022.
2. Ng J, Major PW, Flores-Mir C. True molar intrusion attained during orthodontic treatment: a systematic review. Am J Orthod Dentofacial Orthop 2006; 130:709-14.
3. Abu Arqub S, Al-Moghrabi D, Iverson MG, et al. Assessment of the efficacy of various maxillary molar intrusion therapies: a systematic review. Prog Orthod 2023; 24:37.
4. Taffarel IP, Meira TM, Guimaraes LK, et al. Biomechanics for orthodontic intrusion of severely extruded maxillary molars for functional prosthetic rehabilitation. Case Rep Dent 2019.
5. Kiliaridis S, Lyka I, Friede H, et al. Vertical position, rotation, and tipping of molars without antagonists. Int J Prosthodont 2000; 13.
6. Hakami Z. Molar intrusion techniques in orthodontics: A review. J Int Oral Health 2016; 8:302-6.
7. Fan D, Liu H, Yuan CY, et al. Effectiveness of the attachment position in molar intrusion with clear aligners: a finite element study. BMC Oral Health 2022; 22:474.
8. Choi YJ, Suh H, Park JJ, et al. Anterior open bite correction via molar intrusion: Diagnosis, advantages, and complications. J World Fed Orthod 2024; 13:2-9.

9. Huang GJ. Long-term stability of anterior open-bitetherapy: A review. InSemin orthod 2002; 8.

10. Manea A, Dinu C, Baciuţ M, et al. Intrusion of Maxillary Posterior Teeth by Skeletal Anchorage: A Systematic Review and Case Report with Thin Alveolar Biotype. J Clin Med 2022; 11:3787.

11. AlMaghlouth B, AlMubarak A, Almaghlouth I, et al. Orthodontic intrusion using temporary anchorage devices compared to other orthodontic intrusion methods: A systematic review. Clin Cosmet Investig Dent 2021;11-9.