

Mechanics of Molar Intrusion: A Review

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Abstract

Molar intrusion has always been a difficult treatment approach. It can be considered for treating open bite patients or over erupted molars. Through the decades, various treatment options have been developed to intrude molar teeth, from non-surgical to surgical approaches, and using various appliances, some which rely on patient compliance. The aim of the study is to summarize the existing molar intrusive techniques and appliances with respect to their advantages and disadvantages, and their possible clinical effectiveness.

Keywords: Molar intrusion, Open bite, Supraeruption.

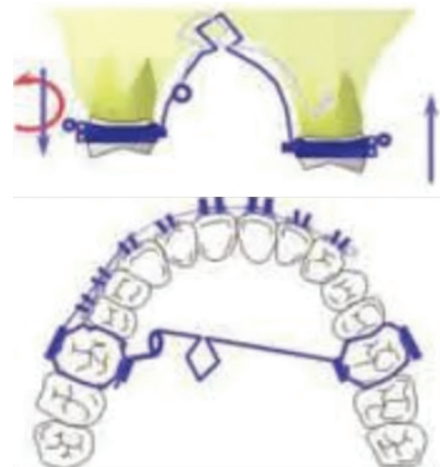
INTRODUCTION

Supra eruption of teeth is basically over eruption of tooth due to lack of opposing force in the occlusion. Because of supra erupted teeth in the arch, there is open bite tendency. 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 correcting the open bite.^[1] Molar supra eruption is mainly caused by missing antagonists and no replacement or by failure of eruption in growing patients. Any situation can complicate the placement of prosthetic restorations and lead to lateral occlusal interferences. Full-coverage restorations can result in a loss of enamel. Furthermore, in a growing patient, a supra erupted molar can delay either the eruption or the bonding of its antagonist. Molar intrusion is particularly difficult to achieve in adults because of the lack of compensation through growth, histological changes in the alveolar bone, smaller marrow spaces, and a decreased blood supply, compared to growing patients. Although several authors have demonstrated the possibility of intruding an supra erupted molar, reported amounts of true intrusion have been modest.

Several molar intrusive treatment strategies have been published, from case reports to clinical trials. The primary objective of this article is to compile various molar intrusion techniques published in the literature. Molar intrusion techniques are mainly of non-surgical and surgical type.

NON-SURGICAL MEANS OF MOLAR INTRUSION

Molar intrusion palatal arch



The palatal arch is made from a rigid .036" stainless steel wire and the helix kept parallel to the long axis of the contralateral molar and makes a U-bend at the midpalate region. Each end of the palatal arch is inserted into palatal cleats on the upper first molar bands. The helix should be activated by inserting

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the helix end first before delivering the palatal arch. Activation produces a force of about 80 g which is sufficient for molar intrusion. As the force will be applied below the center of resistance of the maxillary first molar resulting in a direct intrusion.^[2]

Posterior bite-block



The passive acrylic posterior bite-blocks have also been used for the molar intrusion. These appliance keeps the mandible open by 3–4 mm beyond its resting position which maintains the pressure on the neuromuscular system supporting the mandible. Controlling vertical dimension in patients with skeletal open bite is effective. When intrusion of the posterior teeth is required in adults with excessive vertical facial height, posterior bite-blocks have been unsuccessful treatment option for molar intrusion.^[3]

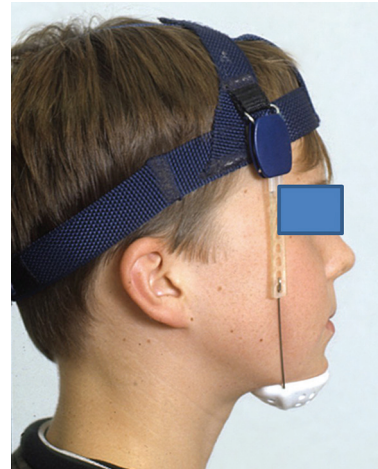
High pull headgear



It has been studied that high pull headgear has been used mainly for producing an orthopedic force to the maxilla to correct Class II as well as open bite malocclusions. It applies 500 g of force to the maxillary first molar for a period of 6-months. It has been claimed that it produces dental changes of intrusion (0.96 ± 0.54 mm) as well as the distal movement (2.6 ± 0.6 mm). 10 More intrusion can be achieved with increase in force levels and keeping headgear treatment over a longer time period. 7 To create these effects, the force should pass through the center of resistance of the maxillary first molar which is located at the level of buccal furcation area. 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

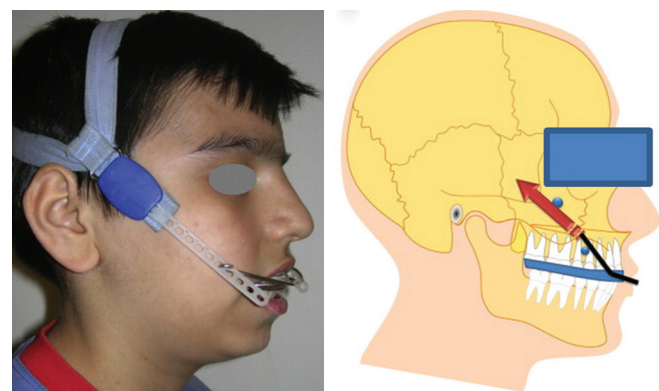
crown mesially or distally, depending on the direction of the force which leads to downward and backward rotation of the mandible. So the use of a trans palatal arch (TPA) is necessary which maintains the arch width and prevents undesirable molar rotation.^[3]

Vertical pull chin cap



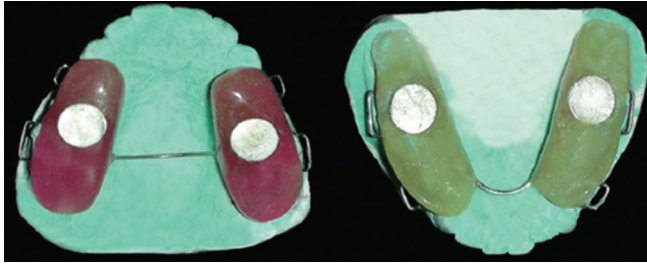
The vertical chin cap or high pull chin cap is one of the functional orthopedic appliances used for the treatment of skeletal open bite. A 400 g of force is applied per side, and the force vector passes through the anteroinferior region of the mandibular corpus up to 3 cm from the outer canthus of the eye.^[4] A study conducted using vertical chin cap for a time period of 6–12 months in a growing subjects with open bite malocclusion had observed, some amount of intrusion of lower molars compared to the control group.^[3]

High pull headgear with a splint



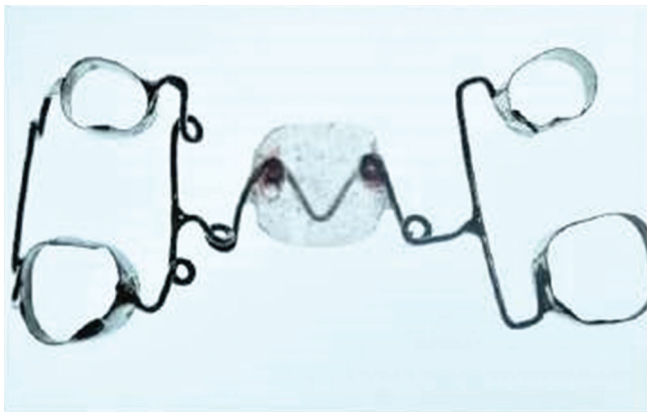
This kind of headgear is used for intrusion of a group of teeth. It works with same principles of high pull headgear and the force is applied to a splint covering the intended teeth. A slight amount of intrusion of maxillary dentition has been reported in the study using head gear attached to a full-coverage upper occlusal splint in patients with the maxillary dentoalveolar protrusion.^[5] However, there is limited literature published specifically regarding this appliance.^[3]

Magnetic bite-block



This appliance was introduced by Dellingerin 1986, by the name active vertical corrector (AVC). 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. These magnetic modules generate the forces between 600 to 650 g per module. It has been considered as an effective mechanics for reduction of the open bite by the intrusion of molar teeth in growing patients. Moreover, the magnetic repelling bite-blocks significantly intrude the molars in adult patients. Although magnetic posterior bite-blocks also shows a quick response in the dental and skeletal vertical relation, it can also help to change the posterior cross bite relations as compared to the passive bite blocks. To maintain arch width, TPA is necessary.^[1]

SAS appliance



This appliance derived its name from the authors, that is, Sombir, Ashok, and Satinder. It consists of bands on premolars and molars and they are connected with 0.032" stainless steel wire. It has four helices, two each on buccal and palatal side of the connecting wire. E chains can be attached to these helices and intrusive effect is achieved on molars.^[5]

Spring-loaded bite-block



This was first described, by Woodside and Linder-Aronson in 1986. Upper and lower bite block are connected with two helical springs which are activated periodically maintaining the forces between 250 and 300 g. Some authors have reported that it possess an orthopedic effect to correct open bite by intrusion of molars in growing patients. However, till date, there are limited data regarding intrusion in adult patients.

MOLAR INTRUSION ALONG WITH FIXED ORTHODONTIC THERAPY

Multiloop edgewise arch wire technique



The multiloop edgewise arch wire (MEAW technique) has been considered as a method to treat cases of severe open bite without the surgical intervention. 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. The treatment changes with the MEAW technique seen mainly in the dentoalveolar region and was very much similar to the natural compensatory mechanism. MEAW appliance shows the extrusion of anterior teeth which limits its use for patients who have excessive dentoalveolar height before starting treatment.^[6]

AVC



The AVC can be a fixed or removable appliance that leads to intrusion of posterior teeth in the maxilla and mandible by reciprocal forces. It works similar to a version of the present day biteblock therapy. The appliance uses the repelling force of samarium cobalt magnets, incorporated in acrylic, for intrusion of the posteriors.^[3]

Rapid molar intrusion device



This has been first proposed by Carano and Machata. It includes two elastic modules secured on the first molars with L-shaped pins. The straight end attaches into upper molar tube and the angulated end attaches to lower tube. When the patient closes the mouth, the modules are flexed and deliver an intrusive force of 800 g on each side. The force level decays to 450 g by the end of the 1st week and 250 g by the 2nd week. As the intrusive forces on the labial surface of the molars generate moment that tips the crowns buccally, this appliance is always placed along with TPA in maxillary and a lingual arch in mandibular arch. The effect of this appliance includes intrusion of the upper and lower first molars significantly seen in growing patients. It can intrude the first and second molars if they are attached together. As, it intrudes both the upper and lower molars simultaneously, it cannot be used for the intrusion of molars in single arch.^[3]

Vertical holding appliance (VHA)



VHA is basically a TPA with an acrylic pad. Theoretically, pressure from the tongue could reduce the eruption of upper first molars during growth. However, it has not been clinically proven. During orthodontic treatment, this appliance is helpful in restricting anterior bite opening by extruding molars during leveling and alignment phase.^[3]

SURGICAL MEANS OF MOLAR INTRUSION

Temporary Anchorage Device's



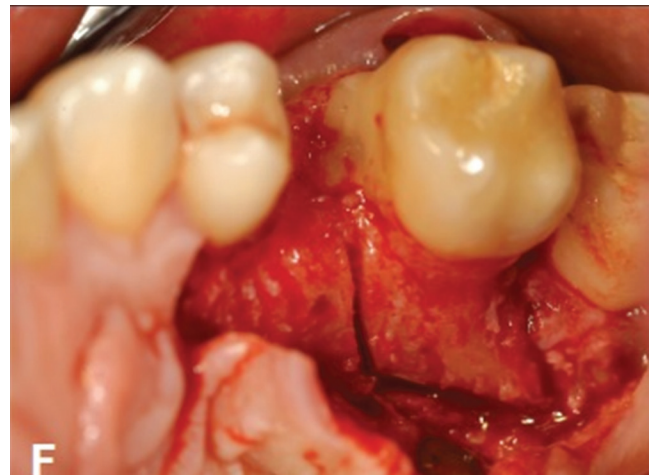
Mini plates

Mini implants(alveolar)

Zygomatic implants

Introduced by Creekmore and Eklund in the vast possibilities of skeletal anchorage systems and inserted vitallium bone screws just below the anterior nasal spine for correction of deep bite malocclusion patients.^[7] Later new sites for implant placement were introduced such as endo osseous implants in the retromolar pad area and the mid palatal implants.^[8] Kanomi and Costa *et al.* introduced the use of miniscrews for orthodontic anchorage purpose. Umemori *et al.* used miniplate first as temporary skeletal anchorage for intrusion of molars in correction of the open bite malocclusion. Since then, many papers involving miniscrews as skeletal anchorage have been published for molar intrusion.^[9]

Corticotomy-enhanced molar intrusion



Corticotomy-assisted orthodontics limits side effects of tooth movement and also increases the rate of tooth movement by increasing alveolar bone turnover rate and reducing bone density. After raising a mucoperiosteal flap, corticotomy is performed selectively for intended molars to be moved.^[9] Vertical cuts were made on mesial and distal surface of interproximal areas starting from 2–3 mm above the alveolar crest. It extends approximately 2–3 mm past the root apices, and then a horizontal corticotomy is done by connecting this interdental cuts. Various methods could be used for intrusion, like an acrylic splint covering the teeth except the teeth to be intruded can have an intrusive force from a coil spring attached to the J-hooks in the buccal and lingual sheaths passing over the occlusal surface. Intrusive forces can also be applied from a repelling magnet acrylic splint, or by skeletal anchorages.^[11]

Osteotomy-assisted molar intrusion



An osteotomy followed by an orthodontic force widely used as a treatment option for tooth movement in cases of ankylosis.^[12] It was shown in a case report, where an osteotomy was performed, and intrusive force was applied from mini plates placed on the zygomatic buttress in an open bite case. More research is required in this treatment strategy of molar intrusion.^[4]

Stability of molar intrusion

The challenging step after orthodontic treatment including molar intrusion in open bite cases is maintaining the position of molars achieved. Different factors which can lead to relapse of open bite cases are, tongue size or posture, respiratory problems, orofacial musculature, unfavorable growth patterns, and tooth movements. A long-term stability is unpredictable in growing patient, particularly, in vertical growers.^[13] Therefore, effective method of retention should be considered in long-term follow-up.

CONCLUSION

This article enlisted some molar intrusion techniques. The mechanics for intrusion of molar or molars usually come with some reciprocal effects on the anchorage units. With the limited

strong evidence, taking skeletal anchorage or, performing any surgical procedures such as corticotomy, to the intended teeth could be more promising in better movements with less side effects. However, future clinical studies are needed to improve the techniques in this regard.

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