บทความปริทัศน์
Review Article

การเคลื่อนฟันกรามเข้าสู่เบ้าฟันเพื่อการรักษาฟันหน้าสบเปิด: บทความปริทัศน์

Molar Intrusion for Treating Anterior Open Bite: A Review of the Literature

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ชม.ทันตสาร 2553; 31(2) : 27-34
CM Dent J 2010; 31(2) : 27-34

บทคัดย่อ

การเคลื่อนฟันกรามเข้าสู่เบ้าฟันเป็นทางเลือกหนึ่งสำหรับการรักษาผู้ป่วยที่มีโครงขากรรไกรแบบเปิดและฟันหน้าสบเปิด การเคลื่อนฟันกรามเข้าสู่เบ้าฟันทำให้ขากรรไกรล่างเกิดการหมุนทวนเข็มนาฬิกาและทำให้ฟันหน้าที่สบเปิดปิดลงได้ เทคนิคหลายเทคนิคได้ถูกนำมาใช้เพื่อเคลื่อนฟันกรามบนและล่างเข้าสู่เบ้าฟัน โดยมีกลไกการทำงานของเครื่องมือที่ต่างกันไป เช่น แท่งกัดฟันหลังแบบไม่ให้แรง แท่งกัดฟันหลังแบบให้แรง เครื่องมือฟังก์ชันนอล ไฮ-พูล เฮดเกียร์ มัลติลูปเอ็ดจ์-ไวส์อาร์ชไวร์เทคนิค และวัสดุฝังเกลียวขนาดเล็กซึ่งถูกใช้เป็นหลักยึดชั่วคราวสำหรับการเคลื่อนฟันกรามเข้าสู่เบ้าฟัน บทความนี้มีวัตถุประสงค์เพื่อทบทวนวิธีการเคลื่อนฟันกรามเข้าสู่เบ้าฟันโดยไม่ผ่าตัด

คำสำคัญ: โครงขากรรไกรแบบเปิด ฟันหน้าสบเปิด การเคลื่อนฟันกรามเข้าสู่เบ้าฟัน

Abstract

Molar intrusion is an option for treating skeletal open configuration cases. Molar intrusion causes counter-clockwise mandibular rotation and anterior open bite closure. Many techniques have been used to intrude maxillary and mandibular teeth by various mechanisms, such as passive posterior bite-blocks, active vertical correctors, functional appliances, and multi-loop edgewise arch wire techniques. Anchorage systems have included high-pull head gear, and recently, miniscrew implants. This article aimed to review all those non-surgical techniques and their mechanisms for molar intrusion.

Keywords: Skeletal open configuration, anterior open bite, molar intrusion.

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Introduction

Treating skeletal open configuration cases is a challenge for orthodontists because of such cases have a multifactorial etiology. In addition, relapse tendency is high.[1-4] Treatment modalities for skeletal open configuration cases include incisor extrusion, molar intrusion and orthognathic surgery. Incisor extrusion is common for closing an open bite; however, it has limitations. In skeletal open configuration cases, incisors have already been over-erupted to naturally compensate for skeletal discrepancy, so incisor extrusion of overerupted incisors causes relapse.[5-6] Skeletal open configuration cases exhibit excessive maxillary and mandibular posterior dentoalveolar height. Molar intrusion is an option for correcting anterior open bite, but not for severe skeletal discrepancy.[7] The molar intrusion causes counter-clockwise mandibular rotation and anterior open bite closure.

Many techniques are used to intrude maxillary and/or mandibular posterior teeth. This review article focuses on non-surgical techniques which are used for molar intrusion.

Passive posterior bite-blocks

Passive posterior bite-blocks are intraoral appliances, which have occlusal coverage that invades the interocclusal space 3-4 mm beyond the rest position (Figure 1). The major effect of the bite-blocks is to simultaneously cause intrusion or inhibit eruption of maxillary and mandibular posterior teeth by using the response of the skeletal musculature.[8] They open the bite several millimeters and stretch the posterior muscles of mastication, causing them to act as intrusive agents on the maxilla.[9] This method is effective in preventing mandibular clockwise rotation in growing patients before cessation of growth of the jaws.[5] For correcting the open bite, passive posterior bite-blocks have two modifications; removable spring-loaded bite-blocks and bite-blocks with repelling magnets or an active vertical corrector.

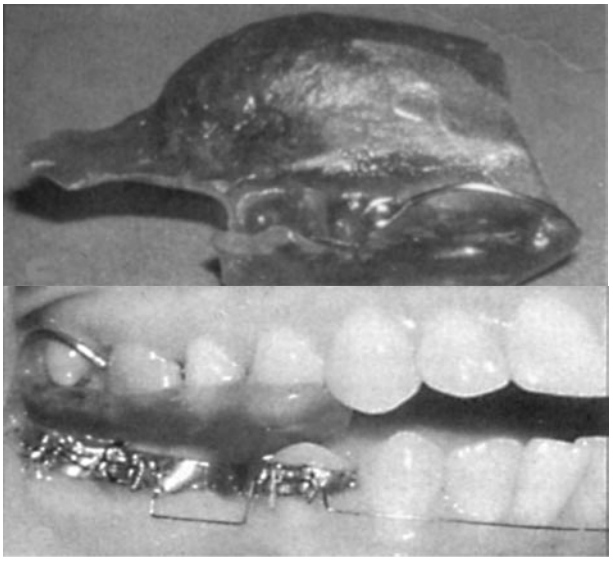

Figure 1 *Passive posterior bite-block. Modified from Subtelny.*[26]

Removable, spring-loaded bite-blocks

Removable spring-loaded bite-blocks are modifications of passive posterior bite-blocks. Maxilla and mandibular bite-blocks are joined to one another by steel springs (0.09 mm) on the labial and lingual sides. The spring can be adjusted to generate force, even in the rest position (Figure 2).[8] The increase in overbite from the use of spring-loaded bite-blocks might be due to slight intrusion of posterior teeth in combination with slight eruption and retroclination of incisors.[8]

Active vertical corrector

The active vertical corrector is a fixed or removable appliance, which proposes to intrude posterior teeth by repelling force from samarium-cobalt magnets. The magnets are placed in the bite-blocks over the tooth to be intruded, and generate intrusion forces to the maxilla and mandible

Figure 2 *Removable spring-loaded bite-blocks. Modified from http://www.sunart-dental.kr/gallery/list.php?pid=66336*

(Figure 3).[5, 9-10] The force generated from this appliance ranges from 600 to 650 g per module.[10] This appliance has been proved to be safe and effective for intruding posterior teeth.[10] Patients are requested to wear active vertical correctors as much as possible, because maximal wearing gives optimal results. It has been found that wearing the appliances for 12 hours per day, including sleeping time, gives acceptable results.[10] This appliance can be used successfully in both children and adults, but growing children show more rapid results.[5] The rate of tooth movement by this appliance is greater than that by conventional techniques, such as passive posterior bite-blocks or high-pull head gear, because the active vertical corrector can produce a more constant force system.[10] Barbre and Sinclair[9] evaluated cephalometric changes after treatment of 25 patients with anterior open bite, using active vertical correctors. The mean pre-treatment age was 10 years 8 months. The active vertical corrector was cemented to the teeth and worn 24 hours per day, including eating periods. Average treatment time was 7.7 months. The mean over-bite decrease was 3.2 mm. Changes were achieved by maxillary and mandibular molar intrusion, combined with upper incisor retraction and eruption.[9] Bite-blocks with repelling magnets are more effective for posterior teeth intrusion than spring-loaded bite-blocks. However, they produce more eruption and uprighting of the incisors than do the spring-loaded bite-blocks.[9]

Figure 3 *Active vertical corrector. Modified from http://aoalab.com/index/aoa-products-activeverticalcorrectors*

Functional appliances

Treating anterior open bite by using functional appliances is based on the theory that the open bite is not caused only by skeletal discrepancy, but also by poor postural performance of the orofacial musculature.[5,11] The open bite bionator and the Frankel's functional regulator type 4 (FR-4) are the functional appliances used for treating open bite cases. The appliance is designed to restrict eruption of the posterior teeth, and is more effective in growing patients. Cooperation of the patients is a key for the success of functional appliance treatment.[5,12] The FR-4 appliance has two buccal shields, two lower lip pads, a palatal bow, an upper labial wire and four occlusal rests on the upper permanent first molars and upper deciduous first molars (Figure 4). The occlusal rests appear to restrict the rate of growth in upper posterior dento-alveolar structures. The FR-4 appliance should be worn for 18 hours per day.[11]

The open bite bionator, a removable functional

appliance, is constructed with shields for the tongue, and upper and lower acrylic posterior biteblocks with or without acrylic coverage of the incisors (Figure 5).[12-13] Previous studies have reported that the open bite bionators/activators were effective in restricting eruption of the maxillary molars with little effect on lower molar eruption, consequently improving over-bite.[5,12-13]

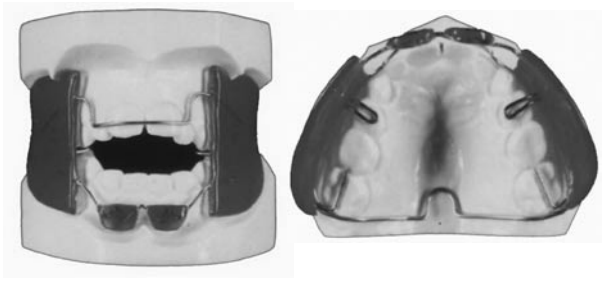

Figure 4 *FR-4 on maxillary and mandibular cast (a), and on maxillary cast (b).*

Modified from Erbey.[11]

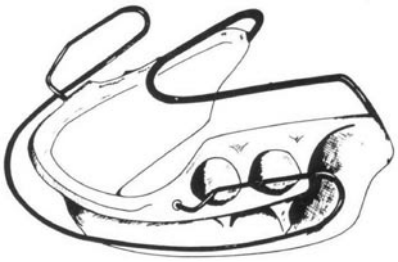

Figure 5 *The open bite bionator. Modified from Graber.[27]*

High-pull head gear

High-pull head gear is another common approach for open bite treatment. The rationale for the head gear use is maxillary molar intrusion.[14] The upward and posterior force generated by high-pull head gear inhibits the eruption of posterior teeth. This allows forward rotation of the mandible and closure of the anterior open bite (Figure 6).[7, 9] Patients must wear high-pull head gear 14 hours per day with a force of 12 ounces or more per side.[15] The inner bow of the head gear can be inserted either directly to the molar tooth band tube or through a maxillary splint. However, Proffit[15] reported that that this type of appliance can restrict the extrusion of the upper molars, but allows extrusion of the lower molars. So, it is difficult to achieve favorable upward and forward rotation of the mandible.[15] High-pull head gear may cause intrusion of maxillary posterior teeth, but the treatment outcome depends heavily on patient compliance.[16]

Figure 6 *High-pull head gear.*

High-pull head gear attached to a functional appliance with bite-blocks

The combination of the use of high-pull head gear and functional appliances with bite-blocks is an effective growth modification approach for children with vertical excess and Class II skeletal relationship.[15] The inner bow of the head gear tube is inserted in bite-blocks in the premolar region. The high-pull head gear can produce orthopedic force close to the center of resistance of the maxilla (Figure 7). This extra-oral force improves the retention of the functional appliance and increases control of all maxillary teeth, not just the molar teeth. The functional bite-blocks enhance mandibular growth, and control eruption of posterior and anterior teeth.[15]

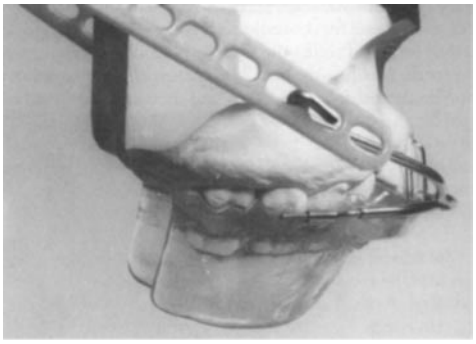

Figure 7 *High-pull head gear attached to a functional appliance. Modified from Graber.*[27]

Multi-loop edgewise arch wire technique

Skeletal open vertical configuration is characterized by divergent upper and lower occlusal plane and mesially inclined of the dentition.[14] Kim developed Multi-loop edgewise arch wire (MEAW) technique and treated this malocclusion with success.[14] The MEAW technique uses a combination of multi-looped 0.016 x 0.022 inch stainless steel arch wires and heavy anterior elastic to achieve molar intrusion, simultaneous anterior tooth extrusion and closure of the bite.[5,14] This method produces an increase in upper and lower anterior dento-alveolar height, but no significant change is found in upper posterior dento-alveolar height. The lower posterior dento-alveolar height is decreased significantly.[5,17] MEAW therapy has minimal effects on skeletal pattern. The open bite is corrected by distal uprighting of posterior teeth and by change of occlusal planes. The treatment changes with the MEAW technique mainly occur in the dento-alveolar region, and are similar to those resulting from natural compensatory mechanisms. Skeletal change is not found when the MEAW technique is used, so it can not reduce lower anterior facial height.[18] The extrusion of anterior teeth, produced by the MEAW appliance, indicates limited usefulness of this technique in patients who have adequate or excessive dento-alveolar height.[5]

Figure 8 *Multi-loop Edgewise Arch Wire Technique. Modified from Kim.*[14]

Skeletal anchorage systems

An important factor for successful molar intrusion is anchorage control. Intra-oral anchorage, such as incorporation of many teeth in the anchorage unit, a transpalatal arch, a lingual arch, Class II and/or Class III elastic traction, or a Nance appliance, may cause undesired tooth movement. Extra-oral anchorage, such as a head gear is used in order to reinforce intra-oral anchorage. High-pull head gear is effective, but it requires patient compliance for a successful result. Skeletal anchorage, such as dental implants, miniplates, and miniscrew implants has recently been used to provide absolute anchorage in many orthodontic treatments, including molar intrusion.[16]

Among the various forms of skeletal anchorage, miniscrew implants have recently and widely been used as orthodontic anchorage because they have many advantages, such as ease of application, minimal need for patient compliance and ability for immediate loading after initial wound healing. The surgical procedure for inserting or removing miniscrew implants is simple, with minimal unfavorable complication. The miniscrew implant is small enough to be placed in many areas and it requires little patient cooperation.[16,19-20]

The sites for miniscrew implant placement in the maxilla are palatal and buccal alveolar process, paramedian area, midpalatal area and zygomatico-alveolar crest. The areas in the maxilla that implantation should avoid are the maxillary anterior region because of lip irritation, and the palatal area of the upper central incisors because of incisive foramen location and thick mucosa. In the mandible, the miniscrew implant is usually placed at the buccal cortical plate of the alveolar process between the second premolar and first permanent molar. The area in the mandible that implantation should avoided is the lingual side because of tongue irritation.[21]

Many authors have reported successful treatments of anterior open bite by molar intrusion using miniscrew implant anchorage.[19,22-23] For molar intrusion, the recommended miniscrew implant placement sites in those studies were the buccal, lingual or both sides of the alveolar bone, the midpalatal area, and the paramedian area. A transpalatal arch and/or a lingual holding arch should be used to prevent tipping of the teeth, especially in cases where the miniscrew implant placement is only on one side. The miniscrew implant diameter in those studies ranged from 1.2 to 2.0 mm and the length ranged from 7.0 to 15.0 mm. The intrusive force should be light and continuous to produce appropriate pressure within the periodontal ligament and to decrease the risk of root resorption.[15] The molar intrusion force used in those studies ranged from 100 to 200 g.[7,16, 23-25]

Techniques of force application to intrude molar teeth by using miniscrew implant anchorage vary (Figure 9). In the maxilla, Xun et al. generated intrusion force by using nickel-titanium coil springs (150 g) connected from the miniscrew implant head to a soldered hook on a transpalatal arch.[23] Park et al. used an elastic thread (100 g) to engage the miniscrew implant head and a soldered hook on a transpalatal arch.[3] Yao et al. applied force by connecting an elastic chain (150-200 g) between the miniscrew implant head and an attachment on a molar band.[16] In the mandible, intrusion force was applied by a power chain connected from the main arch wire to the miniscrew implant head or from a buccal tube on a first molar band to the miniscrew implant head.[3, 23]

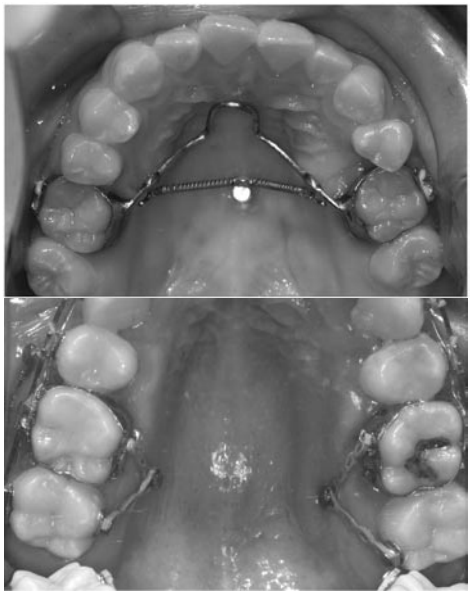

Figure 9 *Molar intrusion with miniscrew implant anchorage.*

The mean intrusion distances for maxillary first and second molar teeth, within a mean intrusion period of 7.5 months, were 3-4 mm and 1-2 mm respectively.[16] Sherwood et al. reported a mean molar intrusion of 4.1 mm after 6.5 months.[6] Park et al. reported molar intrusion rates of 0.5 to 1.0 mm per month without notable root resorption.[19] Xun et al. intruded maxillary and mandibular molars by placing one miniscrew in the mid-palatal area, and two miniscrews in the buccal dento-alveolar region between the lower first and second molars.[23] The mean intrusion distances for maxillary and manbibular molars were 1.8 and 1.2 mm, respectively, within a mean intrusion period of 6.8 months.[23]

Miniscrew implants can be used as an anchorage to obtain pure posterior tooth intrusion with less patient compliance. This is difficult to achieve using conventional orthodontic mechanics.

Conclusions

Many techniques have been introduced to correct anterior open bite by intruding posterior teeth. Patient compliance is an important factor for selecting proper treatment mechanics. Recently, miniscrew implants have been widely used in many orthodontic treatments, including molar intrusion, to provide absolute anchorage so that less patient compliance was required. Further studies are necessary to evaluate long-term stability after posterior tooth intrusion using miniscrew implants.

Acknowledgement:

The authors wish to thank Dr. M. Kevin O Carroll, Professor Emeritus of the University of Mississippi School of Dentistry, USA, and Faculty Consultant at Chiang Mai University Faculty of Dentistry, Thailand, for his assistance in the preparation of the manuscript.

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