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REVIEW

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Mandibular Expansion in Orthodontics: A Review

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ABSTRACT

Treatment planning decisions in the transverse dimension have historically been based on the presenting mandibular arch width and form. There are various surgical and non-surgical methods used to correct the transverse discrepancies. Few of the non-surgical methods include Haas expander, Schwarz appliance, Mandibular lip bumper, beta-titanium arch etc. The surgical methods commonly used for mandibular expansion are corticotomy and mandibular symphyseal distraction osteogenesis.

KEYWORDS: Expansion, Mandible, Non-surgical Methods, Surgical Methods

INTRODUCTION

One of the most common skeletal abnormalities related with small basal and dentoalveolar bone.[1] is transverse mandibular deficit. The mandible has received little attention in comparison to maxillary insufficiency. One of the oldest dogmas in orthodontics is the inviolability of the mandibular intercanine distance.[2] Dental alignment, tooth shape and size, musculature, jaw size and shape, facial and cranial patterns, and the dental occlusion all influence the transverse dimension and shape of both dental arches.[3]

One of the most prevalent malocclusions in the primary and mixed-dentition periods is the transverse discrepancy between the maxillary and mandibular arches.[4] In the primary dentition, 14 % of people have posterior crossbite, while 8 % have it in the mixed dentition.[5] These patients may have short posterior transarch widths, crowding, large buccal corridors, and a loss of anterior arch contour.[6] Although jaw bone constriction is usually associated with posterior crossbite, it is not a necessary condition, as the maxilla and mandible can be dentoskeletal compensated to retain jaw relationships that are functional.[7,8] Patients lacking posterior crossbites, in other words, may have major transverse disparities that require treatment.

Dental extraction and arch extension with orthodontic mechanics are the standard methods for addressing mandibular crowding, however the outcomes are unreliable and prone to relapse, especially in adults. In the therapy of this condition, surgery appears to be the sole option.[9]

Previously, the only way to repair transverse mandibular deficit was to do a vertical symphyseal osteotomy, rotate the two hemi mandibles laterally, place a bone graft, and fix it. Due to the possibility of periodontal problems, a lack of proper stiff fixation, the need for a bone graft, and the risk of relapse, this surgical method was not well received. These issues have been decreased or eradicated as a result of distraction osteogenesis. Theoretically, if the extension is done gently, the soft tissues will adapt better and bone will grow in the osteotomy site[1], resulting in higher stability. MSDO produces regenerated bone, which adds to the dimensions of the intrinsic basal bone, and has a potentially bigger effect than other approaches. The numerous techniques for mandibular expansion will be discussed in this review.

NON-SURGICAL METHODS

Concurrent Maxillary and Mandibular Expansion

Because the maxillary first premolars frequently have a palatal inclination, it's difficult to seat a 4-banded appliance, the Haas expander is adapted for concurrent expansion. To keep the expander in place, the first molars are banded, but the first premolars are bonded with a palatal pad and an occlusal wire. It is recommended that the maxillary expander be turned no more than once every other day.

Two first molar bands are used in the mandibular expander. Two 0.060-inch extension arms are included with the expansion screw. A 0.035-inch wire is soldered to these arms to add the necessary length, allowing the

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wire to extend around 2 mm out from the alveolus before returning to the first molars' midcrown height. This wire continues below the second and first premolars' midcrown level (it can be extended to the canines). For appliance rigidity, the alveolar and midcrown lengths of wire are linked at the first premolar region.[10]

In contrast to maxillary expansion, orthodontists have not generally embraced mandibular expansion in youngsters as a feasible therapeutic option. This is owing to significant evidence that any increase in mandibular intercanine breadth leads to recurrence. RME was paired with mandibular expansion using a Schwarz appliance in a large sample of consecutively treated mixed dentition individuals, according to Brust and McNamara.[11] Both the arch perimeter and the transverse dimension showed clinically significant increases. In another study, O'Grady et al.[12] found that simultaneous enlargement of both arches in children was long-term stable.

The nonsurgical enlargement of the maxillary and mandibular arches is not a "stand-alone" therapy option. It's frequently paired with anterior teeth interproximal reduction (IPR). IPR helps to correct crowding and minimize the degree of black triangles that develop when the incisors are aligned in overlapped teeth and teeth with incisal flare (small at the cervical and broad at the occlusal). The anatomy of the teeth determines the limits of IPR.

According to Adkins et al.[13], for every 1 mm of transarch extension at the level of the first premolar, the arch perimeter increases by 0.7 mm. Thus, arch expansion of 4.0-5.0 mm might create 3.0-3.5 mm of room. Crowding of 4-5 mm can be rectified when paired with IPR. If mandibular crowding is more than 4-5 mm, excision of one incisor or symphyseal distraction osteogenesis may be necessary.

Incremental Expansion Using a Mandibular Lip Bumper

Because of its ability to grow the lower arch, the mandibular lip bumper is useful in nonextraction therapy. Knowing how this device works and how the expansion is dispersed throughout therapy is crucial to using it correctly. The lip bumper enables for both anterior-posterior and transverse enlargement of the mandibular dental arch. It's usually made of 0.0450 stainless steel wire and runs from molar to molar across the mandibular dentition. The wire is kept away from the teeth's facial surfaces, usually near the gingival margin, and may or may not be covered with plastic or acrylic anteriorly. The appliance is designed to fit into tubes on the lower molars and includes adjustment loops just above them. The lip bumper causes forward and lateral expansion of the mandibular dental arch by dislocating the facial musculature, preventing it from coming into touch with the lower teeth, and by allowing the lingual pressures of the tongue to stay imbalanced.

The expansion is thought to occur between the molars, premolars, canines, and an anterior flaring of the incisors, according to the research. The distal push exerted by the facial musculature on the appliance is also employed to tilt the molars distally with the mandibular lip bumper. Many of the dimensional changes that occur during lip bumper use have been quantified by Osborn et al. They discovered that the arch width expanded by 2 mm at the canines, 2.5 mm at the first premolars, 2.4 mm at the second premolars, and 2 mm at the first molars, and the arch length increased by 1.2 mm in their study of 32 patients. Similar findings were found in other investigations.[14]

Mandibular Expansion using Beta-Titanium Arch

The use of a lingual arch or extended archwires for the dentoalveolar growth of an adult mandible has been acknowledged. Different sorts of appliances and processes have employed beta-titanium alloy. Because of its low stiffness and durability, it can be used at various stages of orthodontic treatment. We proposed designing an auxiliary overlay arch for dentoalveolar extension in the maxillary and mandibular arches based on the mechanical properties of beta-titanium wires.[15]

The bimaxillary transverse deficiency was rectified, allowing for the decrease of the wide buccal corridors and the elimination of crowding. As requested by the patient, the grin improvement was achieved with no disruption of speech or swallowing. Vertical and horizontal dental relationships were successfully maintained.[15]

The TMA-EA improved the widths of both dental arches in 60 days. The maxillary intercanine distance grew 4.5 millimeters, the interpremolar distance grew 6 millimeters, and the intermolar distance grew 4 millimeters. Only the interpremolar distance relapsed by 1 mm at the end of treatment; the mandibular intercanine width increased by 3 mm, the interpremolar width increased by 3.5 mm, and the intermolar width increased by 2.5 mm.[15]

When nonsurgical therapy is indicated, an auxiliary expansion arch composed of beta-titanium alloy can be used to correct bimaxillary arch constriction in adult patients. In an adult who was concerned about dental cleanliness, speech, and swallowing due to palatal expanders, the auxiliary arch was an effective way to enhance dentoalveolar maxillary and mandibular expansion.

SURGICAL METHODS

Corticotomy-facilitated Mandibular Expansion

Nonsurgical treatments have been used, including the Schwarz and bihelix appliances, with minimal dimensional change and unclear long-term stability. These investigations found that mandibular arch expansion was limited to alveolar bone and mostly resulted in tooth inclination, with no alterations in the mandibular body. Furthermore, a weakened periodontium as a result of excessive dental expansion and proclination, as well as reduced face aesthetics, have been identified as drawbacks to such therapies. However, combined surgical and orthodontic treatment for adults who require a lateral dimension increase has demonstrated good results. According to recent studies, corticotomy-assisted orthodontic treatment is a widely approved treatment method with a predictable outcome that addresses many of the problems connected with orthodontic treatment.[16]

Selective alveolar decortication is used in corticotomy-assisted orthodontic treatment to generate a state of accelerated tissue turnover, which leads to faster tooth movement and a shorter treatment period. Other benefits of corticotomy-assisted orthodontic treatment include safer extension of restricted arches and improved post orthodontic treatment stability.[16]

Mandibular Symphyseal Distraction Osteogenesis

The narrow mandibular arch is contained in the maxillary arch with crowding of the mandibular teeth in mandibular transverse discrepancy. Mandibular enlargement is difficult to achieve with orthognathic surgery. With symphyseal distraction osteogenesis, the mandibular arch can be adequately expanded without compromising periodontal health. The location and design of an osteotomy are determined by tooth crowding, root configuration, root angulations, space between adjacent roots, the dental and skeletal midline, bone thickness, and bony architecture. To avoid root injury, an intraoral periapical x-ray is beneficial.

The distractor device can be attached to the teeth or the bones. An occlusal coverage orthodontic expansion appliance with a Hyrax expansion screw is produced in a tooth-borne device. 24 hours before surgery, the appliance is cemented. During surgery, micro screws are used to secure the bone-borne device. By using a vestibular technique, the labial cortex is exposed under local anesthetic. The osteotomy site is routinely designated and completed. The appliance is turned on to test that the particles are separated. After a four-day delay, the device is activated twice a day at a rate of 0.5 mm. After a 4- to 6-week consolidation period, orthodontic tooth movement can begin. It is removed under local anesthetic once the consolidation is complete.[17]

The lateral force and strain patterns are significantly affected by the distractor device's orientation. To avoid undesirable biomechanical consequences during bilateral mandibular lengthening, distraction appliances must be placed parallel to the axis of distraction. The lower incisors glide over the palatal surface of the maxillary incisors as the mandible is diverted forward, resulting in a posterior open bite. At this point, box elastic traction should be used to sculpt the callus, allowing for quicker closure of the posterior open bite. To account for relapse, a 2 mm extra distraction should be performed.[17]

A comparable debate currently exists between the three symphyseal distraction designs. Some people believe that using a tooth borne distractor causes more dental/dentoalveolar extension and less skeletal expansion. Other practitioners claim that the bone-borne appliance has a larger skeletal effect because the stresses are applied directly to the mandible. In reality, if the bony resistance is removed (i.e., an osteotomy) and the appliance is rigid enough, the force delivered to the teeth should be directly transferred to the bone, allowing only skeletal changes to occur. During surgically aided fast maxillary expansion, this has been observed several times in the maxilla.[18]

Stability of transverse expansion in the mandibular arch

Because of the distalization of the molars into the narrow region of the wedge, leading in a clockwise rotation of the jaw, non-extraction therapy can sometimes expand the bite or enhance the vertical dimension. All transverse dental cast measurements changed significantly after using the expansion

equipment. Concurrent treatment with the edgewise appliance may have contributed to reductions in arch crowding, arch perimeter, and arch length. According to Housley JA et al, a mandibular fixed edgewise appliance combined with an increasing lingual arch for fewer than 6 months caused an increase in both the transverse and sagittal dimensions of the mandibular arch. The posterior area of the mandibular arch was more stable than the anterior region in terms of transverse expansion. Fixed retention was the sole way to keep the mandibular intercanine width expansion. Lip protrusion did not develop despite the advanced and proclined maxillary and mandibular incisors.[19] The distraction effect can be maintained with any of the normal forms of retention, however the Essix type retainers may not be firm enough to maintain the increased transverse dimension. If an Essix retainer is needed for patient comfort and compliance, it should only be worn during the day and a Hawley retainer should be worn at night. A fixed lower canine-to-canine wire will keep the canine width and anterior alignment in good shape, but it won't help with any posterior expansion. As a result, a Hawley retainer with an integrated lingual support wire is an effective mandibular retention device.[18]

CONCLUSION

Crowding and transverse mandibular deficits can be treated differently with symphyseal distraction osteogenesis. Distraction may offer the same aesthetic benefits as traditional orthodontic expansion techniques, but without the risk of relapse. Mandibular symphyseal distraction osteogenesis is a minimally invasive technique that is performed in a dentist chair under local anesthesia. A basic teeth-borne distractor device can be included into a dental appliance, or a bone-borne distractor device can be fastened to the symphysis with small bone screws. To avoid teeth migration to immature callus during the consolidation period, the interdental space should be maintained.

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