Regaining Leeway Space and Anterior Crossbite Correction with a Modified Maxillary Molar Distalizing Appliance

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During the mixed dentition stage, adolescents experience rapid dental and skeletal development. Unfortunately, many of them do not visit the orthodontist early enough and miss out on the opportunity to take advantage of preventive and interceptive orthodontic treatment. This article describes the management of regaining leeway space and correcting anterior crossbite using a modified maxillary molar distalizing appliance.
Keywords: *space regainer, children, distalizing appliance leeway space, anterior crossbite*

INTRODUCTION

Due to the high prevalence of caries found in second primary molars, these teeth are often lost prematurely.[1] Normally the eruption of the first permanent molar is guided by the distal surface of the second primary molar, so leeway space is a fundamental factor that allows for a normal exchange of deciduous for permanent teeth.[2] When premature loss of a second primary molar occurs and the primary molar space is not maintained, the first permanent molar moves forward before the second premolar can erupt. If leeway space can be proactively preserved until the second premolar is in place, there would be a long-term advantage for the patient.

Anterior crossbites are some of the most common orthodontic problems in growing children. The first step in treating them is to determine whether they are dental or skeletal in nature. Abnormal axial inclination of maxillary anterior teeth can often result in dental anterior crossbites. Skeletal anterior crossbites, in contrast are usually part of a skeletal problem such as maxillary retrognathism, mandibular prognathism or a combination of both.[3] Anterior crossbites can result in fractures of anterior teeth, abnormal enamel abrasions, periodontal pathology, and poor esthetics of the dentofacial complex.[4,5] Furthermore, habitual mandibular malpositioning and an inappropriate pattern of jaw musculature related to crossbite may adversely affect jaw growth and ultimately result in temporomandibular joint disorders.[6] Therefore, orthodontic/orthopedic treatment is recommended for anterior crossbites as soon as possible.

This article presents a method for regaining leeway space and correcting anterior crossbite using a modified maxillary molar distalizing appliance.

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Case Report

A 9-year and 5-month-old male patient presented with chief complaints of anterior crossbite (Figure 1). A review of his medical history showed nothing remarkable. He exhibited a mesofacial, symmetrical face and a slightly concave profile. A clinical examination showed an early mixed dentition. His maxillary first molars were mesially tilted and rotated due to early loss of his primary maxillary second molars. There was inadequate space for the eruptions of maxillary second premolars. The patient showed an end-on Class II molar with -2.5 mm overjet and 30% overbite. The mandibular dental midline was deviated to the right about 1 mm. He also showed a gingival recession on the right mandibular central incisor. His sister also showed an anterior crossbite. The etiology of the malocclusion was determined to be a combination of heredity and environmental factors.

A panoramic radiograph evaluation demonstrated the presence of the permanent dental series. Lateral cephalometric analysis revealed a skeletal Class III (ANB = -2.7°) with a hypodivergent growth pattern (SN-MP: 31.6°). The maxillary incisors showed slight retroclination (U1 to SN: 101.5°) and the mandibular incisors were retroclined (IMPA: 85.4°) (Figure 2 and Table).

The specific treatment objectives were to stimulate growth of the maxilla, establish a Class I molar relationship by distalizing the maxillary first molars, correct the anterior crossbite, improve the gingival recession of the mandibular right central incisor, improve the patient's smile and facial esthetics, and monitor the development of the permanent dentition along with mixed dentition space to estimate the size of unerupted permanent teeth.[7,8]

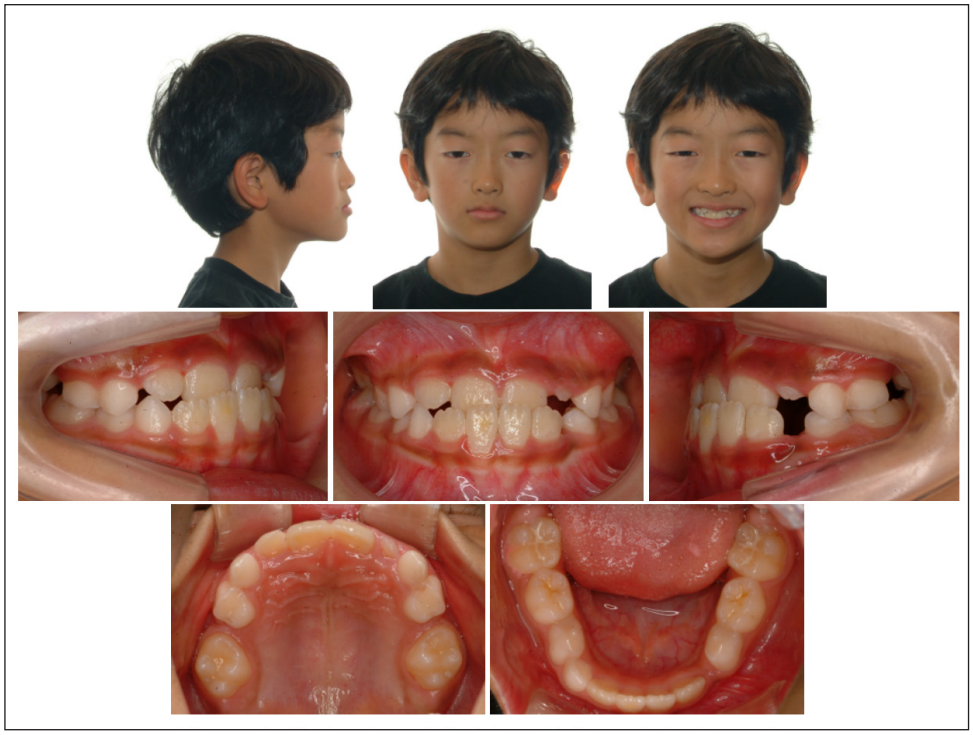

Figure 1. Pretreatment facial and intraoral photographs.

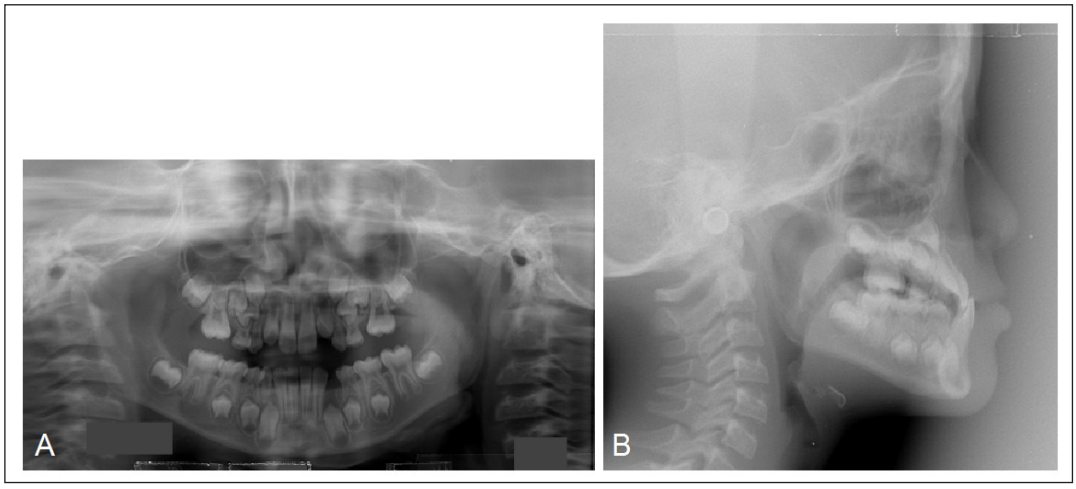

Figure 2. Pretreatment radiographs; **A.** panoramic radiograph; **B**, lateral cephalogram.

Since the patient was still growing and had a concave profile, the primary treatment objective was to correct his crossbite by promoting maxillary growth to achieve skeletal improvement. He and his parents were presented with option of facemask therapy to stimulate the maxillary growth forward and improve the overjet during the Phase I treatment, but they declined the use of a facemask. Due to skeletal discrepancies with an unfavorable growth pattern, surgical treatment is an option in the future after patient growth is complete. This option was discussed.

Appliance Design

To correct anterior crossbites and regain maxillary leeway space, a modified maxillary molar distalizing appliance (MMMDA) can be fabricated with a .032″ stainless steel wire (SS) and run across the lingual surface of the maxillary anterior teeth to the posterior anchorage teeth (the primary maxillary first molar bands or permanent maxillary first premolar bands). In the present case, if the patient had been willing to use a facemask with elastics, the elastics could have been engaged at the posterior buccal tubes attached to the deciduous maxillary first molar bands. The .032″ SS wire can either be soldered or secured with ST locks (Dentsply International,

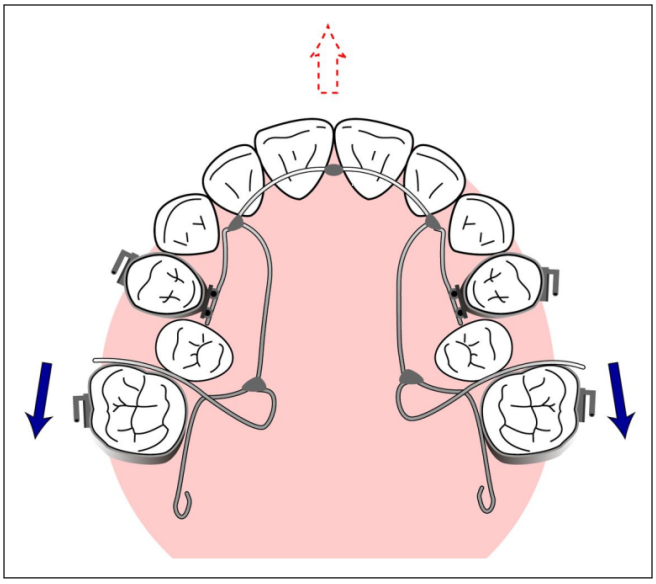

Figure 3. Modified maxillary molar distalizing appliance (MMMDA). The anterior crossbite is corrected by the reactive force produced by the distalizing components.

York, PA) to engage the posterior anchorage teeth. Then .032″ SS wires can be soldered between the lingual surface of the maxillary laterals and canines and extended posteriorly, and .024″ cobalt-chromium (Co-Cr) alloy finger springs can be soldered to these wires to distalize the maxillary first molars. Additionally, .035″ Co-Cr alloy wires can be soldered to the .032″ SS wires to distalize the molars in the right direction as guide wires (Figure 3).

RESULTS

A two-phase treatment was planned, using an MMMDA to distalize the maxillary first molars and correct anterior crossbites. The reactive force produced by the distalizing components corrected the anterior crossbite and maxillary leeway space was regained in 5 months. After the appliance was removed, a W-Arch fixed expander was used to maintain the space and to correct the posterior crossbite. All permanent teeth erupted successfully after the Phase I treatment (Figure 4).

When the patient was 13-years and 2-month-old, he started his Phase II treatment. After 13 months of routine orthodontic treatment, he showed Class I molar and canine relationships and acceptable overbite and overjet. His gingival recession on the right mandibular central incisor, his smile and profile esthetics were all improved. Following the treatment, a 0.0175 inch twistflex wire was bonded from lateral incisor to lateral incisor on the maxillary arch and from canine to canine on the mandibular arch (Figure 5).

A panoramic radiograph evaluation demonstrated proper root parallelism with no significant sign of bone or root resorption. Lateral cephalometric analysis revealed an improvement of the skeletal pattern (ANB = -1.5°) with an increase in the mandibular plane angle (SN-MP: 33.0°). The maxillary incisors were proclined (U1 to SN: 112.4°) and mandibular incisors showed retroclination (IMPA: 81.0°) (Figures 6, 7, and Table).

DISCUSSION

Most orthodontic problems begin between the ages of 7 and 11 during the early transition from primary to permanent dentition.[9] During this period, the masticatory apparatus, including the dental arches and occlusion, undergo rapid development.[10] Unfortunately, many patients do not see a pediatric dentist or orthodontist soon enough and therefore miss the opportunity to take advantage of the benefits of early treatment.

To examine the effects of premature extractions of deciduous teeth, previous studies used the primary molar sites (D + E space).[11,12] They showed significant closure for each extraction group in both arches, but teeth in the maxilla and mandible behaved differently. The initial rate of space loss in the maxilla was greater than that of the mandible, but after the second year of absence, the annual maxillary space loss tended to level off. The mandibular

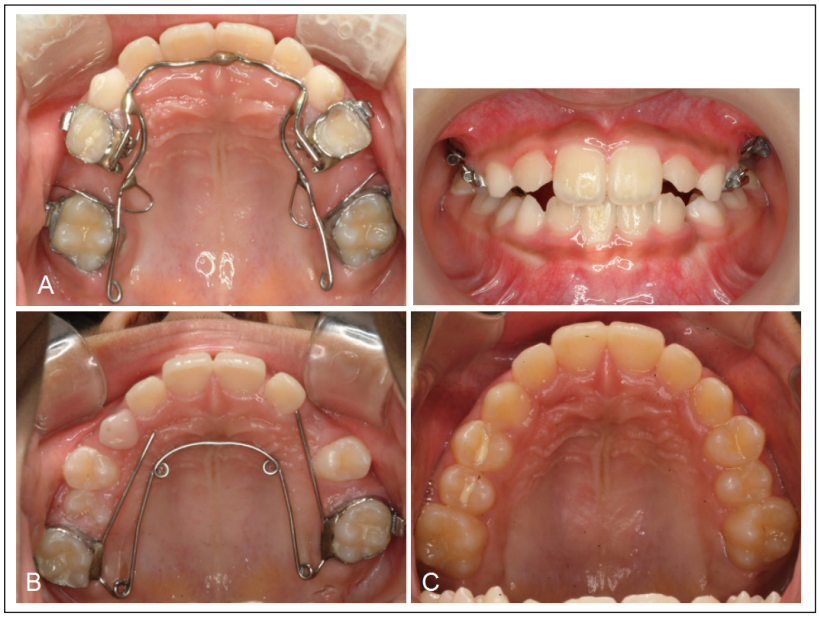

Figure 4. Progress intraoral photographs; **A,** 5 month treatment with a MMMDA showing regaining leeway space and anterior crossbite correction; **B,** a W-Arch fixed expander; **C,** after the Phase I treatment.

Figure 5. Posttreatment facial and intraoral photographs after 14 months of Phase II treatment.

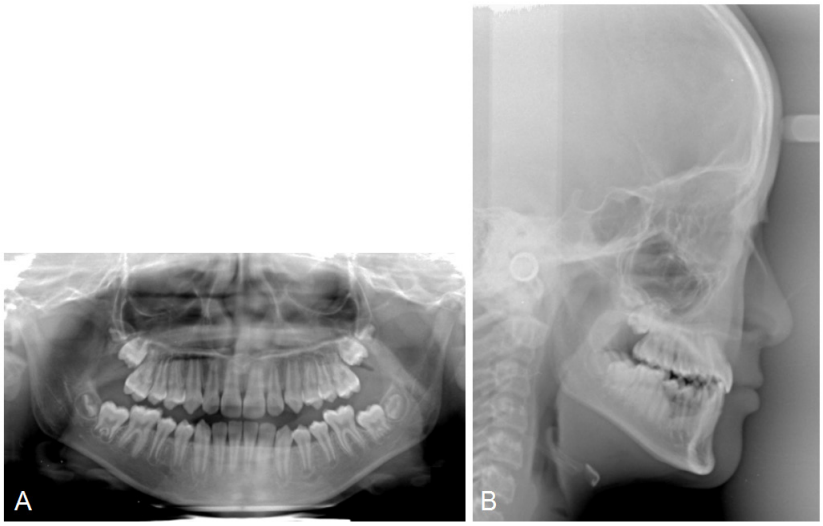

Figure 6. Posttreatment radiographs; **A,** panoramic radiograph; **B,** lateral cephalogram.

extraction groups, on the other hand, continued to lose space at a rather constant rate.[11,12]

The definition of impaction varies among clinicians. Kuftinec *et al* [13] defines impaction as a condition in which an embedded tooth in the alveolus is prevented from eruption or a tooth is locked in position by bone or by the adjacent teeth. If the timing of eruption is delayed in terms of both chronological and dental age (mean ± 2 SD), it is unlikely that the permanent tooth will erupt without orthodontic intervention.[14]

If the primary maxillary second molar is lost early, the maxillary second premolar will generally tend to be impacted due to the mesial shift of the first molar and the distal shift of the canine and primary first molar. As the first premolar generally has an eruption timing advantage over the second premolar, it will erupt earlier into the site maintained by the primary first molar, often with a distal drift. The resultant lack of space between the permanent molar and first premolar causes impaction of the second premolar. The canine could also be affected, but the impaction tendency is less than for the second premolar.[11,12]

It is more common for patients with anterior crossbites to be referred for early treatment than those with lost leeway space because the crossbite condition is more apparent. According to the literature, dental (pseudo-) Class III is usually corrected by alternation of incisor inclination.[15-17] With cooperative patients, a facemask can be utilized can be used to treat skeletal Class III malocclusion in the early or late mixed dentition.[18] However, it is of great impor-

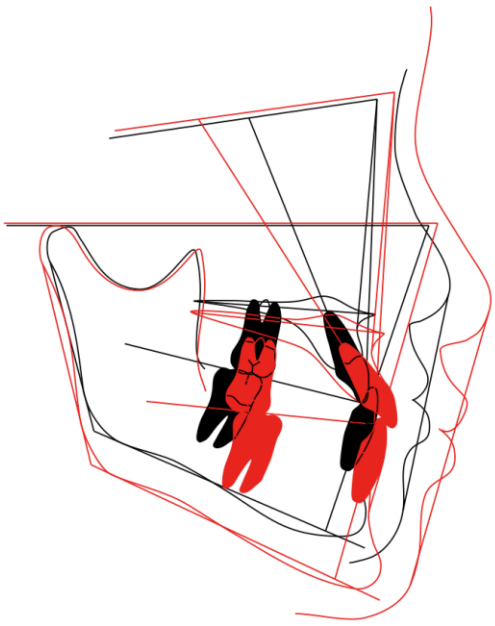

Figure 7. Cephalometric superimposition. Black, pretreatment; red, posttreatment.

Table Cephalometric measurements.

Measurement	Norm	Pre treatment	Post treatment
SNA (°)	82.0	76.7	77.2
SNB (°)	80.0	79.4	78.7
ANB (°)	2.0	-2.7	-1.5
Wits (mm)	1.1	-9.3	-3.2
SN - MP (°)	34.0	31.6	33.0
FH - MP (°)	28.2	23.3	25.1
LFH(ANS-Me/N-Me)(%)	55.0	51.1	51.6
U1 - SN (°)	104.0	101.5	112.4
U1 - NA (°)	22.0	27.0	37.5
IMPA (°)	90.0	85.4	81.0
L1 - NB (°)	25.0	16.4	12.6
U1/L1 (°)	124.0	139.3	131.4
Upper lip (mm)	1.2	-0.4	0.8
Lower lip (mm)	2.0	2.5	1.8

tance to note that the result of this type of early treatment is variable and depends largely on the etiology of the anterior crossbite along with the initial age of intervention.

According to the studies,[19,20] if a clinician is looking to achieve more skeletal change and less dental movement, treatment with a facemask should be considered during the early mixed dentition. There is an increased probability of favorable craniofacial growth with earlier treatment.[21] Gu *et al* [22] compared the treatment effects of a simple fixed appliance and facemask in correction of anterior crossbites. Their study reported that the facemask group showed a combination of skeletal and dental changes. Skeletal changes contributed to 40% of the overjet correction while dental changes contributed to the remaining 60%. In contrast, the 2 × 4 group showed only dental changes in relation to overjet correction.

In the present case that used just an MMMDA appliance, we observed not only proclination of the maxillary anterior teeth but also skeletal changes including Wits changes (from -9.3 mm to -3.2 mm). Even though the patient did not use a facemask during his treatment, his anterior crossbite was corrected by what would have otherwise been an adverse side effect of the anchorage unit.

Variations in diagnostic criteria between dental and skeletal Class III patients can have important clinical implications for the timing and mode of treatment. Hägg *et al* [17] reported that early treatment of patients with anterior crossbite due to dental Class III malocclusion should be very stable over time. In their study it was reported that 5 years after treatment, all 25 patients maintained positive overjet. Sufficient positive overbite depth is necessary to maintain a stable occlusion and once it has been achieved, relapse is rare. Differential diagnosis of dental and skeletal Class III malocclusion is important to successfully treat anterior crossbites. Skeletal Class III malocclusions may be more difficult to treat and perhaps require greater intervention such as facemask therapy accompanied by a greater possibility of relapse. Simple dental corrections are not effective in these cases.

Rabie and Gu[23] defined a dental Class III as a Class I molar and canine relationships with an anterior crossbite compared to Class III molar and canine relationships with an anterior crossbite in the skeletal Class III. Interestingly, in this case, because the patient had lost his primary maxillary second molars early, he showed end-on Class II molar relationships. If we had extended cantilever arms on the maxillary first molar bands so that he could wear a facemask, the maxillary first molar would have moved forward and consequently, the leeway space would have been lost. This, in turn, could possibly result in the impaction of the erupting maxillary premolars.

To make room for the unerupted maxillary second premolars and to correct the anterior crossbite, fixed orthodontic appliances with open coil springs could be applied, but in the mixed dentition stage, it is difficult to bond certain teeth if they are not fully erupted or if the primary teeth have mobility. In addition, if the open coil springs are applied between the maxillary first premolars (or primary first molars) and the maxillary first molars to make room for the impacted maxillary second premolars, it could cause unwanted side effects such as the movement of roots on the adjacent teeth. The MMMDA might reduce these problems.

This appliance has proven to be effective in correcting dental anterior crossbites with retroclined maxillary incisors while simultaneously regaining the necessary maxillary second premolar space. In the present case, we used an appliance and what would have been an adverse side effect on the anchorage unit was used to correct the anterior crossbite.

CONCLUSION

The MMMDA is a simple appliance that can be used effectively for regaining maxillary leeway space in early or late mixed dentitions and for correcting anterior crossbite.

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