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Anteroposterior and Transverse Dento-alveolar Changes After Slow Maxillary Expansion

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Abstract

Antero posterior and transverse maxillary deficiency and maxillary crowding in children are problems commonly encountered and treated by orthodontists. Maxillary arches are expanded early to relieve crowding, and create broader and more esthetic smiles. Two basic approaches have been developed to expand the maxilla one is rapid maxillary expansion uses heavier interrupted forces to maximize orthopedic effects and other is slow palatal expansion which uses lighter continuous forces to move teeth at rates purported to be more physiologic. In growing individuals, the slow expansion is commonly accomplished with removable expansion plates or fixed wire appliances such as the W-arch or the Quad-helix. The slow expansion provides primarily buccal translation of the molars and does not require patient compliance; removable plates tend to tip the teeth buccally. This article presents of successfully treated case series where the crossbite was corrected using slow palatal expansion.

Keywords: Crossbite, Quad helix, Slow expansion.

Introduction

Crossbite is defined as a malocclusion resulting from the lingual positioning of the maxillary teeth in relationship to the mandibular teeth. An anterior crossbite is present when one or more of the upper incisors are in linguo-occlusion (reverse over jet). This may involve just a single tooth or could include all four upper incisors. Dental crossbite has a reported incidence of 4-5% and usually becomes evident during the early mixed dentition phase.

Etiology and pathophysiology factors which causes dental crossbite include a palatal eruption path of the maxillary anterior incisors; trauma to the primary incisor resulting in lingual displacement of the permanent tooth germ; supernumerary anterior teeth; an over-retained necrotic or pulp less deciduous tooth or root; odontomas; crowding in the incisor region; inadequate arch length; and a habit of biting the upper lip. So, various treatment methods have been proposed to correct anterior and posterior dental crossbite, such as tongue blades, reversed stainless steel crowns, fixed acrylic planes, bonded resin-composite slopes, and removable acrylic appliances with finger springs.

Anterior crossbite in the early mixed dentition are believed to be transferred from the primary to the permanent dentition and can have long-term effects on the growth and development of the teeth and jaws. So, early cross-bite corrections lead to a stable and normal occlusion pattern and contribute to symmetrical condyle growth, harmonious TMJ,

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Figure 1: 13-year-old female patient with Class I malocclusion with crowding before treatment.

and overall growth in the mandible. In order to prevent the long term effects of anterior and posterior crossbite, slow expansion is done to unlock malocclusions and by expanding the dental arches allows the proper vertical closure.

Increase in maxillary arch width has been related to orthodontic movements, orthopedic movements, or a combination of these movements during expansion procedures. While the relative degree and nature of these movements is affected by various factors, the general pattern of maxillary expansion may be described [1-3].

Two basic approaches have been developed to expand the maxilla. Rapid maxillary expansion uses heavier interrupted forces to maximize orthopedic effects, and slow palatal expansion uses lighter continuous forces to move teeth at rates purported to be more physiologic. Slow expansion is commonly accomplished with removable expansion plates or fixed wire appliances such as the W-arch or the quad-helix [1].

The objective of rapid palatal expansion is to produce maximum transverse separation of the maxilla while minimizing concomitant tooth movement within the bone. Even though, rapid expansion therapy is to produce immediate bone repositioning while minimizing time tooth movement, there has been dissenting opinions in the orthodontic literature regarding the desirability and necessity of rapid expansion [6-7].

In slow expansion devices, Quad helix appliance and slow expansion devices have become an integral part of the Bio progressive technique. The Quad helix appliance as described by Ricketts in 1975, or the earlier “W” appliance were used with great success in the early treatment. These appliances are mostly used to correct malocclusions and to

Tabel 1: Cephalometic values are depicted.

Measurements	Before treatment	After treatment
SNA	78º	82º
SNB	75º	80º
ANB	3º	2
N per. To A(mm)	0	0
N per.to POG	-5	-4
FMA	35º	23º
Angle of inlination	83º	87º
Y-axis	72º	58
Ar-Go-Gn	132	125º
Nasolabial angle	97º	63
UI-NA	20º	40º
UI-NA (mm)	2	7
U1-SN	98º	117
L1-NB	25º	21
L1-NB (mm)	4	5
IMPA	82	86
Inter incisal angle	133	123
Upper lip - E-line (mm)	-3	2
Lower lip - E-line (mm)	0.5	5

establish normal function and arch form by expanding the dental arches. They also act as an adjunct in the treatment of Class II malocclusions and mostly in cases in which molar derotation is required as part of the treatment. A series of case reports describes the use of a simple fixed appliance along with a slow expansion device and a hyrax appliance to manage anterior and posterior crossbite in the growing individuals.

Case Report

A 13-year-old female patient complained of irregularly placed upper and lower front teeth. Extra orally, she had a balanced face with a pleasant profile, with the maxillary dental midline coincident with the facial midline. There was no deviation of chin from the facial midline but had incompetent lips with inter-labial gap of 5.0 mm. She presented in the mixed dentition stage with Angles Class I malocclusion with premolars erupting in upper and lower arches. An anterior crossbite involving all the maxillary incisor teeth except permanent left central incisor, with buccally placed 13,23 (Figure 1).

Panoramic radiograph showed a favorably erupting 33 and calcification of 38,48. On cephalometric analysis, the patient was diagnosed as skeletal Class I with retro gnathic maxilla and mandible, vertical growth pattern, retrusive chin, increased mandibular length, increased maxillary anterior & posterior dentoalveolar heights with retro-clined upper anteriors (Table 1).

Treatment objectives

The treatment objectives were to correct the axial inclination of upper anterior teeth, to correct Upper and lower anterior crowding, to correct cross bite i.r.t 11,22, to achieve lip competency and to maintain Class I molar relationship.

Treatment plan

Initially we planned for maxillary arch expansion using Quad helix. Later levelling and alignment followed by space closure is planned. This case was done non extraction treatment because the patient had normal naso labial angle, straight profile with straight divergence.

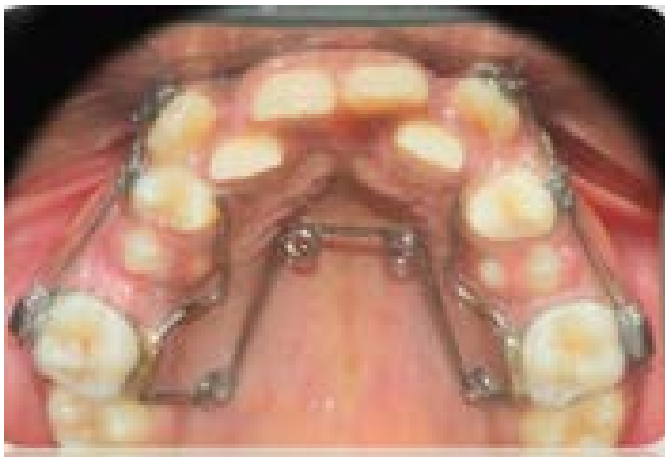

Figure 2a: Slow expansion using Quad helix.

Figure 2b: After appliance removal.

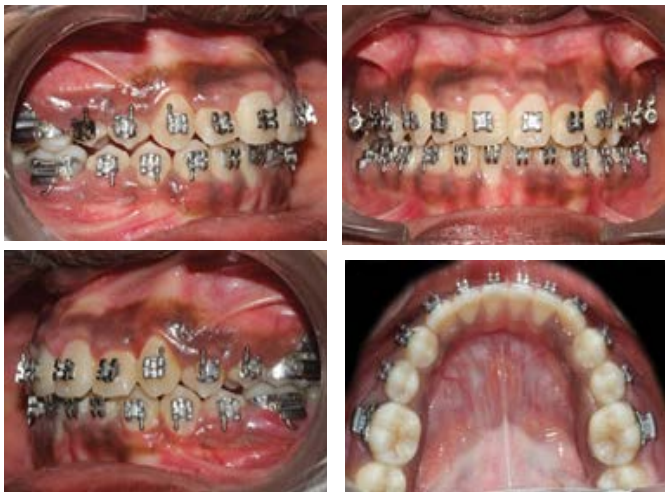

Figure 2c: Levelling and alignment of both arches.

Treatment progress

Orthodontic treatment was initiated with standard .022" × .028" MBT metal bracket prescription. Initially Quad helix was placed to correct malocclusion which result in proper arch width (Figure 2a), simultaneously upper arch was

Figure 3: Patient after 18 months of active treatment.

Figure 4: Retention using fixed bonded retainer in the upper and lower arches.

Figure 5: 11-year-old male patient with crowding and anterior deep bite before treatment.

Figure 6a: Slow expansion using banded hyrax appliance.

Figure 6b: After expansion.

Figure 6c: Levelling and alignment of both arches.

bonded and segmental canine retraction was done using Bennet method. Leveling and alignment was done using continuous arch wire starting from.014" to .020" stainless steel arch wires. Expansion was done for 6 months with 7 mm of expansion (Figure 2b). Later the Quad helix is used as retention in upper arch. After leveling and alignment in upper arch, lower arch was bonded and continuous wire is placed. Time period for levelling of upper and lower was 11 months (Figure 2c). To improve inter cuspation, patient was given settling elastics and advised to use for two months. Upper and lower lingual 3-3 retainer wire was bonded, and a removable wraparound upper retainer was prescribed for 6 months of wear (Figure 4).

Treatment results were Class I molar relation was maintained and Class I canine relation was achieved on both the sides. Upper and lower midlines coinciding with facial midline. Good inter-cuspation of maxillary and mandibular teeth is seen and final panoramic radiograph showed acceptable root parallelism and integrity, with the upper and lower incisors better positioned in their bony bases. Good facial profile and functional harmony is achieved. Lip competency was achieved (Figure 3).

Case Report

A 11-year-old boy reported with a chief complaint of forwardly placed upper front teeth. Patient had a history of fall from bed 4years back, upper front tooth got displaced. The extra-oral examination a meso-cephalic head shape, a meso-prosopic face, a mild convex profile with normal nasolabial angle. The smile was unaesthetic due to his labially placed right central incisor. The patient showed a good range of mandibular movements and no temporomandibular-joint symptoms. On intral oral examination reveals Angle Class II malocclusion, anterior deep bite, and right lateral posterior crossbite with buccally placed permanent right central incisor. Mild anterior crowding is seen in mandible, upper midline is shifted to right by 1mm and lower midline shifted to right by 2 mm (Figure 5). On examining lateral cephalo gram patient wasskeletal Class I bases with retro gnathic maxilla and retro gnathic mandible, average growth pattern, retro clined upper anteriors, with decreased upper and lower dento-alveolar heights (Table 2).

Treatment objectives

To achieve normal axial inclination of incisors with normal overjet and overbite, to correct lower anterior crowding, to correct rotations, to correct molar relation, to correct cross bite, to correct upper and lower midline shift.

Treatment plan

0.022'' MBT metal bracket prescription. Bilateral expansion with unilateral distallization. Extraction treatment was not preferred because patient had normal nasolabial angle, straight profile and competent lips.

Table 2: Post treatment Cephalometric values are depicted.

Measurements	Before treatment	After treatment
SNA	78º	80º
SNB	74º	78º
ANB	4º	2
N per. To A(mm)	-6	-2
N per.to POG	- 10º	-5
FMA	27º	29º
LAFH(mm)	61	63
Angle of inlination	87º	89º
Y- axis	50º	52
Ar-Go-Gn	125	128º
Nasolabial angle	103º	101
UI-NA	12º	15º
UI-NA (mm)	3	4
U1-SN	88º	118
L1-NB	25º	27
L1-NB (mm)	4	3
IMPA	94	92
Inter incisal angle	135	130
Lower lip – E-line (mm)	3	2

Treatment progress

Initially banded hyrax expansion screw was given at posterior region (Figure 6a). The screw was expanded with one-quarter turn daily for 6 months. Expansion of 5 mm was achieved (Figure 6b). Later upper and lower arch was bonded using standard .022" × .028" MBT metal bracket prescription. The expansion screw was used as retention appliance. Levelling and alignment was started in both the arches (Fig. 6c). After levelling and alignment unilateral distallization was done using pendulum appliance on right side. For good finishing and detailing, settling was given and advised to use for 3 months. Fixed bonded retainer was given in upper and lower arches from canine to canine. Treatment results were Class I molar relation and Class I canine relation was achieved on both the sides. Upper and lower midlines coinciding with facial midline. Proper settling of teeth was done and final panoramic radiograph showed acceptable root parallelism and integrity. Good facial esthetics is achieved (Figure 7).

Discussion

The significant increase in maxillary inter-molar and inter-canine arch width produced by the slow expansion appliance was sufficient to correct the space discrepancy and crossbite either anterior or posterior. Studies stated that the use of palatal expansion appliances in younger patients and

Figure 7: Patient after 5 years of post-retention.

found that in his sample, these appliances produced a slight mid-palatal separation of 0.92 mm and also reported that the majority of the change was of an orthodontic nature and that the average inter-molar expansion was 5.88 mm [9].

In the first case report, where Quad helix is used, there is significant increase in inter canine width and inter-molar width because action of the Quad helix appliance is to buccally expand and to distally rotate the maxillary molar teeth. In addition to achieving desired maxillary expansion, the Quad-helix appliance presented no significant patient tolerance problems while offering the advantages of continuous force application. The continuous nature of force application produced by the quad-helix appliance apparently reduces the need for appliance adjustments during maxillary expansion. Adding the 6-week retention period to the mean active expansion time of 30 days, the total appliance wear time approximated 3 months [10-13].

Initial expansion of quad-helix appliance is equivalent to a distance one half the bucco-lingual width of the most posterior molars and to the facial edge of the primary canines produced sufficient force to accomplish orthopedic separation of the mid-palatal suture in each of the ten subjects. The pattern of sutural separation paralleled that generally reported in the literature, with the greatest separation appearing anteriorly. The 6-week retention period appears adequate in sustaining the cross-bite.

In the second case report, the amount of expansion through banded hyrax gained is 5.8mm at canine region. A transient midline diastema may be observed during the early stages of palate expansion, after that the bio-

elastic activity of the stretched periodontal and palatal tissues restores normal incisor alignment through mesially oriented up righting movements [7,13-14]. The recoil tendency of the periodontal and palatal tissues and muscle actions in the lateral area are considered significant factors in returning expanded (i.e., laterally tipped) posterior teeth to pretreatment angulation ranges, once retention is discontinued. The palatal separation is more at the alveolar crest and less at the palatal vault, resulting a triangular expansion pattern with the base near the incisors and the apex toward the nasal area.

Conclusion

The early and proper diagnosis of crossbite is essential to prevent the further occlusal discrepancies in the permanent dentition. Adequate treatment modalities should be advocated to correct the crossbite. Proper retention should be given to the individual as the stability of the expansion treatment is less.

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