Maxillary Expansion in Cleft Lip and Palate using Quad Helix and Rapid Palatal Expansion Screw

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Abstract

Background: Management of patients with cleft lip and palate (CLP) includes orthodontic treatment prior to bone grafting. Palatal expansion is done using slow or rapid palatal expansions (RPE). Controversy still exists regarding choice of expansion appliances used. This study was conducted to find out whether the Quad helix appliance represents a reasonable alternative to using conventional rapid maxillary expansion appliance among cleft lip and palate patients.

Methods: Twenty cleft lip and palate patients had orthodontic study models taken prior to expansion and at the end of expansion. There pre and post treatment study models were analyzed for changes in intermolar width, molar tipping and molar rotation. **Result:** The difference in molar tipping, increase in intercanine and molar width between slow palatal expansion (SPE) and rapid palatal expansion (RPE) group was not statistically significant. A difference between the two groups was found in the ability to rotate molars.

Conclusion: The clinical findings suggest that maxillary expansion using the Quad helix appliance represents a reasonable alternative to using conventional rapid maxillary expansion appliances among cleft patients.

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Key Words : Cleft lip palate; Orthodontics; Expansion

Introduction

Orthodontic treatment plays an important part in the overall rehabilitation of the child with cleft palate. For maxillary expansion in cleft lip and palate (CLP), children orthodontic's use both rapid and slow palatal expansion.

Slow palatal expansion (SPE) procedures produce less tissue resistance around the circum-maxillary structures and therefore improve bone formation in the intermaxillary suture, which should theoretically eliminate or reduce the limitation of rapid palatal expansion (RPE). Aim of this study was to find out whether the Quad helix appliance represents a reasonable alternative to using conventional rapid maxillary expansion appliance among cleft patients. Maxillary dental changes were compared using Quad helix appliance to a rapid palatal expansion appliance.

Material and Methods

The study comprised of 20 cleft lip and palate patients. Only subjects with unilateral complete cleft lip and palate and bilateral complete cleft lip and palate with maxillary transverse deficiency were included in the study. All relevant patient information was recorded. The sample was randomly divided into 10 slow palatal expansions using Quad helix and 10 Rapid palatal expansions (Hyrax).

Slow palatal expansion appliance: The Quad helix was constructed by bending 0.038" round Elgiloy wire. Prefabricated molar bands were fitted on the first molars and palatal sheaths welded. The Quad helix was then secured in to the palatal sheaths on the molars (Fig. 1). The appliance was expanded to 6mm. Subsequent reactivations of Quad helix were done at six week intervals, always extraorally before replacements. Expansion was considered adequate once the occlusal aspect of the maxillary lingual cusp of either the permanent first molar or primary second molar contacts the occlusal aspect of the mandibular facial cusp of either the permanent first molar or primary second molar.

The rapid palatal expansion appliance: Midpalatal hyrax expansion screw using stainless steel metal framework was soldered to bands on the maxillary first permanent molars and first premolars and in the case of a mixed dentition, the maxillary first permanent molars and primary second molars. The appliance was cemented to the maxillary anchor teeth (Fig. 2). Patients were instructed to activate the jackscrew two times per day, once in the morning and once in the evening. Each turn or activation of the jackscrew produced 0.25 mm of expansion, or 0.5 mm of total expansion per day. Expansion was considered adequate once the occlusal aspect of the maxillary lingual cusp of the permanent first molars or primary secondary molars contacted the occlusal aspect of the mandibular buccal cusp of either the permanent first molar or primary second molar.

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Alginate impressions were taken and study models prepared immediately before and after expansion treatment. The widening effect was measured as increase in inter canine width measured to the nearest 0.5 mm between cuspal midpoints of canines. A molar expansion was measured at the central pit of the maxillary first molar.

To evaluate the amount of maxillary molar rotation, polyvinylsiloxane impression putty caps were placed on the maxillary first molars of the pretreatment dental casts. While the putty was still soft, goniometer wires (0.018 x 0.025 rectangular wires) were placed into the putty over the first molar parallel to the occlusal plane, so that they intersected when observed from occlusal. A photograph was then taken perpendicular to the occlusal plane at a distance of 20 cm (wires to lens). A line was constructed perpendicular to left wire and angle (A) of pretreatment goniometry was measured. The putty caps with wires were then transferred to the post treatment casts and the photograph was repeated in the same parameters, Angle (B) of post treatment goniometer was also measured (Fig. 3). The angle formed on the pretreatment casts (A) minus the angle formed on the post treatment casts (B) was then taken as measurement of the amount of molar rotation.

To evaluate the amount of maxillary molar tipping, polyvinylsiloxane impression putty caps were placed on the maxillary first molars of the pre treatment dental casts. Orthodontic wires were placed into the putty over the central pit of the first molar. A photograph was then taken from heel of the cast parallel to occlusal plain at a distance of 20 cm. The putty caps with wires were then transferred to the post treatment casts and the photograph was repeated in the same parameters (Fig. 4). Tracing of the pre post treatment wires were then made. Pre and post treatment tracing were then superimposed on each other. Average was recorded as the total amount of molar tipping.

Result

Material included unilateral complete cleft lip and palate group (n =11) and bilateral complete cleft lip and palate (n = 9). A total of twelve boys and eight girls were treated. Table 1 shows intercanine width change, intermolar width change, molar rotation and molar tipping in SPE and RPE group (Figs. 5, 6) . The RPE groups showed mean increase in intercanine width 5.25 ± 2.45 mm. Mean increase in intermolar width of 5 ± 1.5 mm, mean molar tipping of 6.5 degrees and mean molar rotation of 1.6 degrees were recorded in the RPE group.

The difference in molar width increase between the two groups was not statistically significant $p = 0.250649$ (>0.05) at 95% confidence interval. The difference in intercanine width increase between the two groups was not statistically significant ($p = 0.09480$). The difference in molar rotation caused by the two appliances was highly significant, $p = 0.00001019$ ($p < 0.05$). Both the SPE group and RPE group produced statistically significant increases in buccal molar tipping. A difference between the two groups was found in the ability to rotate molars with the SPE group producing a

Table 1

Intercanine width change, intermolar width change, molar rotation and molar tipping in SPE and RPE group

	Slow palatal expansion		Rapid palatal expansion	
	Mean	SD	Mean	SD
ICWC mm	8.5	3.65	5.25	2.45
IMWC mm	4.35	2.30	5.0	1.5
MR degrees	26.60	16.30	1.60	2.70
MT degrees	7.0	4.5	6.5	2.5

ICWC = Intercanine width change IMWC= Intermolar width change MR = Molar rotation MT = Molar tipping

statistically significant change in molar rotation of 26.60 degrees.

Discussion

Maxillary transverse deficiency can either be treated by RPE or SPE. High magnitude forces used in RPE maximize skeletal separation of midpalatal suture by overwhelming the suture before any dental movement or physiological sutural adjustment can occur. Hence, advocates of rapid maxillary expansion believe that it results in minimum dental movement (tipping) and maximum skeletal movement [1]. The disadvantage of using rapid palatal expanders include discomfort due to traumatic separation of the midpalatal suture, inability to correct rotated molars, requirement of patient or parent cooperation in activation of the appliance, bite opening, relapse, micro trauma of the temporomandibular joint, root resorption, tissue impingement, pain and labor-intensive procedure in fabrication of the appliance. Advocates of slow expansion appliances have questioned the need of such large rapid forces for sutural separation [2].

The ease with which the palatal expansion was achieved in the current study corroborates the observations of Lilja et al [3]. In CLP patients, the palatal suture system is disturbed and either irregular or absent. These factors allow an orthopedic response to Quad helix expansion. Other authors [4,5] have also noted that skeletal resistance in the transverse direction is reduced in cleft palate patients because of the special anatomical situation in the jaw and palate area.

Bell et al [6] found the average increase between the maxillary cuspids and first molar to be 3.62 mm and 6.70 mm, respectively. They theorized that part of the increase in maxillary intermolar width was due to facial tip of molars. The pattern of widening in this study was uniform postero-anteriorly (5 mm and 5.25 in the molar and canine respectively). This can be explained by the fact that the treatment group showed less resistance. The absence of the midpalatal suture also means that pregrafting expansion accomplishes skeletal segmental movement at the expense of increasing the cleft width.

Fig. 1 : Quad helix appliance

Fig. 2 : Rapid palatal expansion appliance

Fig. 3 : Evaluation of molar rotation

The Quad helix appliances were used with great success in the treatment of those patients with cleft palate in whom the lateral maxillary segments had collapsed because of the bony defects.

McNally et al [2] have suggested that buccal root torque can be placed in the molar bands before cementation of the appliance, molar derotation is best accomplished by leaving the anterior arms of the Quad helix away from the lingual surfaces of the cuspid teeth. As the molar teeth derotate, the anterior arms will come to push against the cuspid teeth and they will then expand together with the rest of the maxillary teeth. He also stated that skeletal movement and segment rotation can occur easily with appliances as simple as removable Quad helix. Frank et al [7] using slow maxillary expansion (Quad helix) found 5.88 mm increase in intermolar width. Other studies also suggest that maxillary expansion using the Quad helix appliance represents a reasonable

Fig. 4 : Evaluation of molar tipping

Fig. 5 : Maxillary arch before expansion

Fig. 6 : Maxillary arch after expansion

alternative to using conventional rapid maxillary expansion appliances among cleft patients [8].

The dental changes compare favourably with that of Manuel et al [9], who examined changes with fixed slow maxillary expansion appliance.

A difference between the two groups was found in the ability to rotate molars with the SPE group producing a statistically significant change in molar rotation. Similar results were also found in the literature [10]. Since RPE appliances are rigid and are fabricated from pretreatment dental casts, it is expected that during expansion there would be very little, if any rotations of the molars. On the other hand, Quad helix group expansion appliances are flexible and designed to cause mesiobuccal rotation of a molar that is mesiolingually rotated.

Similarly, both expansion groups also showed significant increases in buccal molar tipping. Garib et al

[11] concluded that minimal buccal tipping of the molars occurs with rapid expansion and more buccal tipping is seen with slow expansion. Their study however was conducted on non cleft patients. Although molar tipping was found to be a contributor to explaining intermolar width change, the difference in molar tipping in both the technique did not signify a specific technique causing excessive molar tipping. This may be due to less palatal resistance in children with cleft lip and palate.

We concluded that both Quad helix and RPE appliance are clinically capable of expanding the maxilla and correcting posterior crossbites in cleft lip and palate. The expansion occurs by increasing the distance between the cleft segments. The Quad helix expansion appliances have the ability to correct rotated molars whereas, the RPE appliance do not. The clinical findings suggests that maxillary expansion using the quad helix appliance represents a reasonable alternative to using conventional rapid maxillary expansion appliances among cleft patients.

Conflicts of Interest

None identified

Intellectual Contribution of Authors

Study Concept : Col MR Vasant (Retd)

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