

CASE REPORT

F-quad helix for simultaneous maxillary expansion and tooth alignment in patients with unilateral cleft lip and/or palate

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Funding information

Danube Private University, Grant/Award Number: Publication APC, if accepted

Key Clinical Message

Illustrating F-quad helix with extension arms that simultaneously expand maxillary arch and rotate its central incisor adjacent to the alveolar cleft while aligning palatally ectopic canines. Incisor rotation occurred before alveolar grafting, while canine traction was performed after alveolar grafting. The construction of this appliance is shown in detail.

KEYWORDS

cleft lip, cleft palate, orthodontics, palatal expansion technique

1 | INTRODUCTION

Collapse of the maxillary anterior segment is one of the most common features in patients with repaired unilateral cleft lip/palate^{1,2}, which occurs partly due to the alveolar defect and also because of the palatal scar tissue after surgical closure.³⁻⁵ In such cases, orthodontic clinicians must perform maxillary expansion to align the collapsed segment and correct cross bites.^{4,6-11} Expansion should be carried out before secondary alveolar grafting in the mixed dentition stage^{4,7,11,12} before the eruption of the permanent maxillary canines.^{4,12-17}

The quad helix appliance provides a fixed lingual arch appliance that produces maxillary expansion when used in the treatment of maxillary constriction or cross bite in the mixed dentitions^{18,19} Anterior and posterior loops increase its range of motion, produces more flexibility, and enhances the rotation of molars.²⁰ The quad helix appliance also offers continuous force without adjustment responsibility for the patient. The appliance has particular usefulness for cleft palate patients because of the continuous force and its ability to concentrate more force anteriorly.¹⁹ The F-quad helix gives clinicians a multi-modal

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TABLE 1 Patients in the study.

Patient	Sex	Age at start of Tx (years)	Cleft side	Age at alveolar grafting	Age at insertion of Quad helix	Duration of Quad helix and tooth alignment	Start of Quad helix
1	F	8y	Left	8y 6 m	8y	6 m	Before alveolar grafting
2	M	12y 4 m	Left	12y 4 m	12y 8 m	6 m	After alveolar grafting

appliance capable of correcting many orthodontic defects simultaneously and quickly.

2 | CASE REPORT

Two patients with unilateral cleft lip and/or palate with posterior crossbites (Table 1), received F-quad helix made from 0.036-inch stainless steel, with extension arms to apply couples necessary to rotate correctly the maxillary central incisor adjacent to the alveolar cleft and align the palatally ectopic maxillary canine on the cleft side. Both patients completed their treatment with 0.022 MBT prescription appliances and wires.

2.1 | Patient #1: Protocol for simultaneous maxillary expansion and rotation of the maxillary central incisor before alveolar bone grafting

1- Bend the anterior and posterior helices with sufficient distance between the maxillary central incisors and the anterior helices to accommodate the extension arms (Figure 1).

2- Define the direction of the couples needed to rotate the maxillary central incisor.

3- Mark the outer arm between the maxillary central incisors and bend the wire perpendicular gingivally with proper adaptation to the anterior palate. It should end with a hook pointing opposite to the rotated central incisor to retain the elastomeric chain (Figure 1).

4- The other arm should cross between the anterior teeth from the palatal to the facial side. The occlusion should be checked to keep the wire away from the opposing teeth. If insufficient space exists, disarticulation will provide patient comfort. Still, CLP patients usually have sufficient space for this wire. The hook should be bent distally to retain the elastomeric chain (Figure 1).

5- Solder the prepared quad helix to the first molar bands and activate it for expansion before cementing the appliance.

6- Bond one button on the lingual surface of the rotated central incisor and a bracket on the facial surface (Figure 2).

7- Attach light elastomeric chains (0.3–0.6 Newtons) from the button and bracket to the hooks (Figure 2).

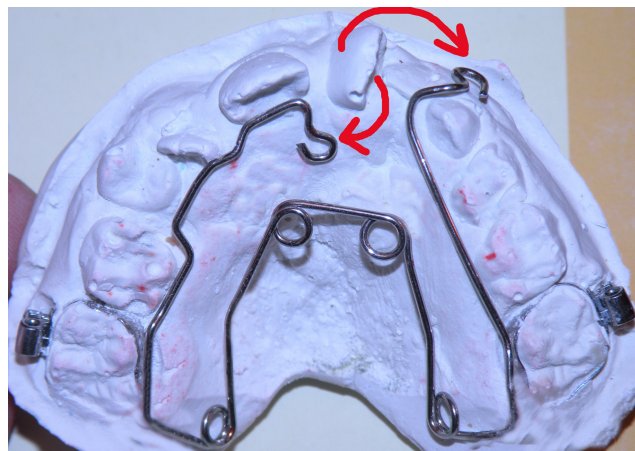


FIGURE 1 Anterior and posterior helices bending.



FIGURE 2 Device clinical bonding.

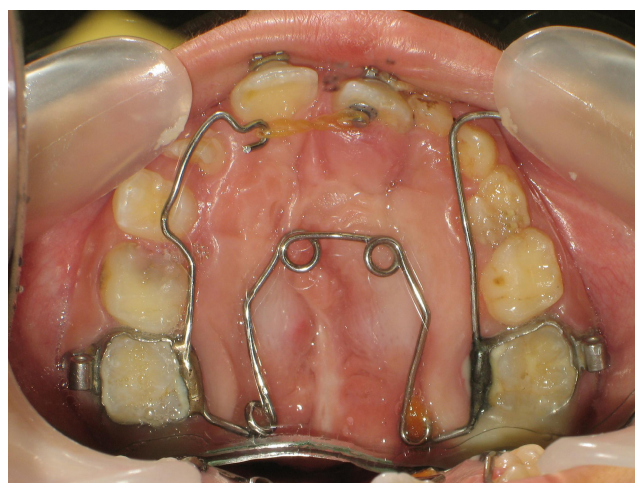


FIGURE 3 After teeth derotation correction.



FIGURE 4 The device arms removal prior to alveolar bone grafting.



FIGURE 5 Orthodontic leveling and alignment with wires.



FIGURE 6 Post clinical occlusal view.

8- The maxillary arch will expand even as the maxillary incisor rotates. Only 2 to 3 expansion activations plus elastomeric changes will usually suffice to achieve the desired improvements (Figure 3).

9- The anterior arms and the hooks are removed prior to alveolar grafting to clear the way for the surgical operation (Figure 4).

10- Fixed orthodontic appliance is used to start leveling and alignment of the arch (Figure 5), till final goals are achieved (Figures 6,7).

Pre-Periapical (Figure 8), pre-occlusal (Figure 9), pre-panoramic (Figure 10) and post-panoramic radiographs (Figure 11) are presented.

2.2 | Patient #2: Protocol for Simultaneous maxillary expansion and traction of an ectopic maxillary canine 3 months after alveolar bone grafting

1- After adjusting the anterior and posterior helices, bend two hooks in the outer arms. Their position, shape and direction of the hooks depend on the patient's clinical needs and the forces needed. In this case, the hooks were bent and adapted facially to the ectopic canine for ease of traction (Figure 12).



FIGURE 7 Post clinical frontal view.



FIGURE 8 Preclinical periapical x-ray.

2- The quad helix was expanded anteriorly more than posteriorly to expand the first premolar area and to create sufficient resistance to begin traction of the ectopic canine (Figure 13).

3- Cement the quad helix (Figure 14).

4- Bond two buttons (or one button and one bracket) on the facial and lingual surfaces of the canine and use elastomeric chains as needed (Figure 14).



FIGURE 9 Preclinical occlusal x-ray.

5- After 2 months of the initial activation and some elastomeric changes, the ectopic canine approximated the periphery of the arch (Figure 15).

6- We removed the mesial arm of the quad helix when it restricted further movement of the canine. The elastomeric chain now extended from the distal hook of the first molar to the canine.

7- After 4 months of the initial activation, the ectopic canine moved facially and distally, towards the periphery of the arch.

8- A Multiple loop arch wire of Australian 0.016-inch wire completed the final alignment of the canine.

Pre-Panoramic (Figure 16) and post-panoramic (Figure 17) views extracted from CBCTs are presented, along with Pre-axial occlusal (Figure 18) and post-axial occlusal (Figure 19) views.

3 | RESULTS

Both patients used F-quad helices satisfactorily. The extension arms were not disfigured and did not cause any gingival irritation. The maxillary central incisor adjacent to the alveolar cleft successfully rotated without tipping into the alveolar cleft. No gingival recession



FIGURE 10 Preclinical panoramic x-ray.



FIGURE 11 Post clinical panoramic x-ray.

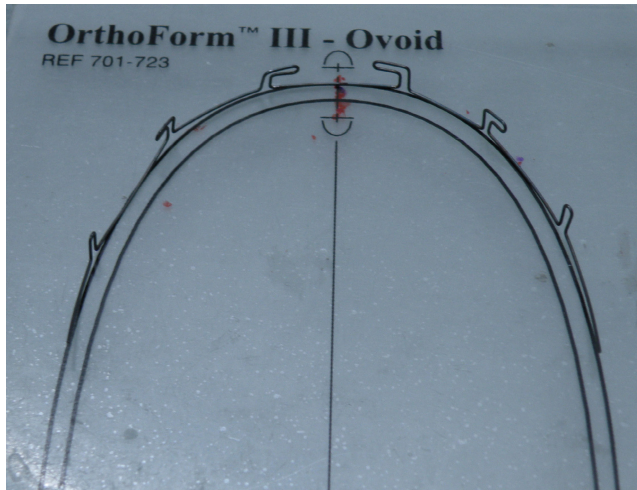


FIGURE 12 Multiple loop arch wire adapted facially to the ectopic canine for ease of traction.

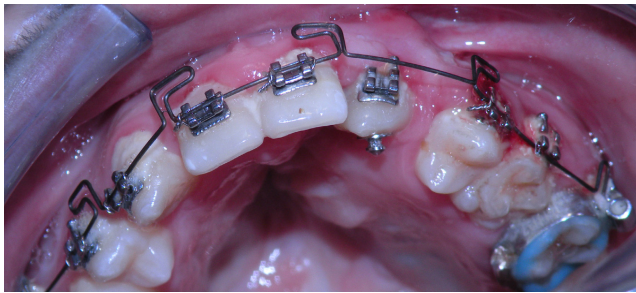


FIGURE 13 Quad helix expanded anteriorly more than posteriorly.

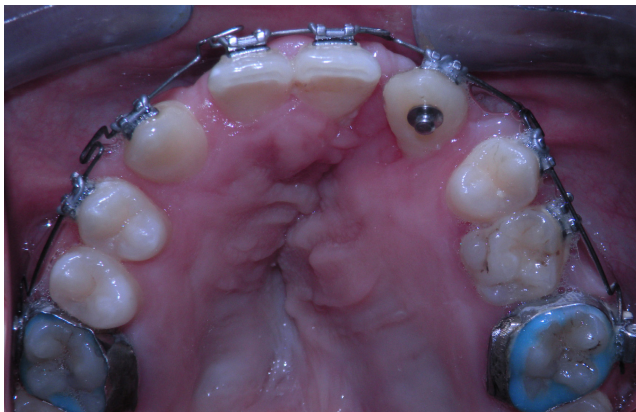


FIGURE 14 Quad helix cementation.



FIGURE 15 Clinical ectopic canine alignment- Frontal view.

occurred post treatment. The palatally ectopic maxillary left canine successfully aligned. The extension arms prevented undesirable tipping of the adjacent maxillary dentition and preserved the space available for the canine tooth.

4 | DISCUSSION

Quad helices have proven their effectiveness in expanding narrow maxillary arches in CLP patients.²¹⁻²⁶ These appliances produced not only dentoalveolar expansion at the canine and molar areas, but also a slight orthopedic maxillary expansion^{22,23,25}, with little relapse.²⁵ As a slow maxillary expander, the quad helix, when used in the mixed dentition in patients with CLP, can be an alternative to conventional rapid maxillary expansion (RPE) appliances.^{22,23,26} It produced more anterior palatal diameter and greater symmetry of the dental arch than did rapid maxillary expanders.²¹ For our patients, we modified ordinary quad helices as a F-quad helix with anterior extension arms. Since Urbaniak et al,¹⁹ in 1988 found no difference between 0.036-inch Elgiloy and 0.036-inch stainless steel, we made the F-quad helices from 0.036-inch stainless steel and expanded them every 6 weeks by 8 mm activation distance as recommended by Urbaniak et al.¹⁹ We created pure rotation (a moment with no net force) with couples, which consisted of two forces of equal magnitude, with parallel but non-collinear lines of action and opposite senses. Although a single force can produce a rotation but cannot produce pure rotation.²⁷ Ormco's power chain generation II was used, as it was shown to have less force degradation than others with highest percentage of force remaining.²⁸ Weissheimer et al,²⁸ discovered that after 21 days, the force levels of tested elastomers had reduced to less than half. Force degradation was similar after 21 and 35 days.²⁸ As a result, the elastomeric chain was changed every month in our situation. The force levels used to correct rotations ranged from 0.3 to 0.6 Newtons as recommended by Proffit et al.²⁹ The force was accurately measured using Correx force gauge from Dentaurem Germany.

Unilateral cleft lip and palate (UCLP) patients frequently suffer from rotations of teeth adjacent to the alveolar cleft especially the maxillary central incisors. Among 195 southern Chinese children with complete cleft lip and palate, maxillary central incisors alongside the alveolar cleft were rotated in 78.1% of UCLP children and 95.9% with Bilateral cleft lip and palate (BCLP) children.³⁰ Moreover, lateral or central maxillary incisors rotations were found in 31.1% of 90 Italian patients with isolated cleft lip, unilateral and bilateral cleft lip and

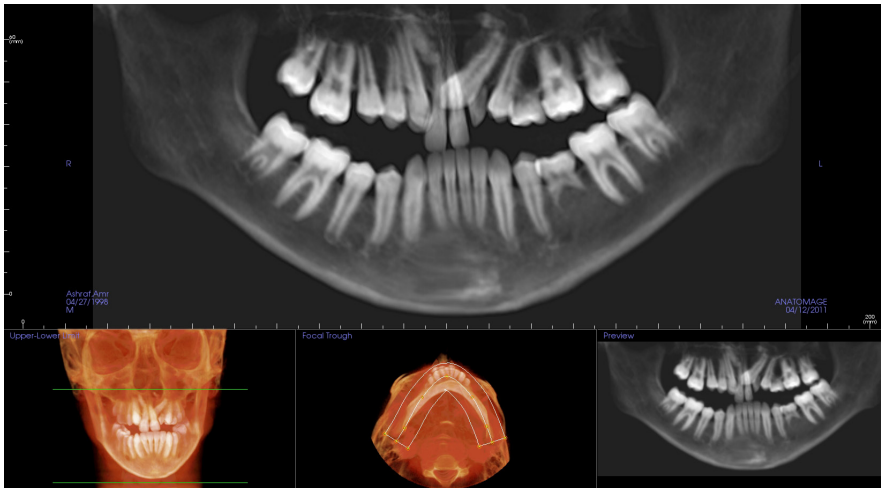


FIGURE 16 Preclinical panoramic x-ray.

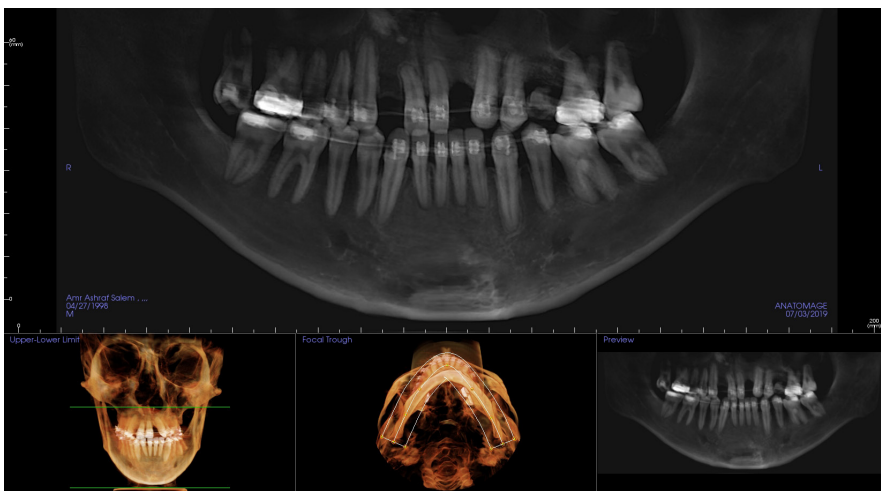


FIGURE 17 Post clinical panoramic x-ray.

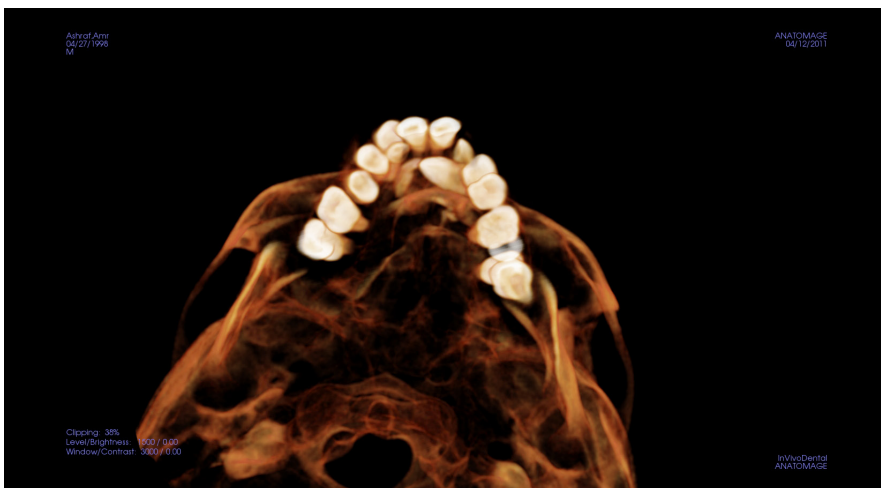
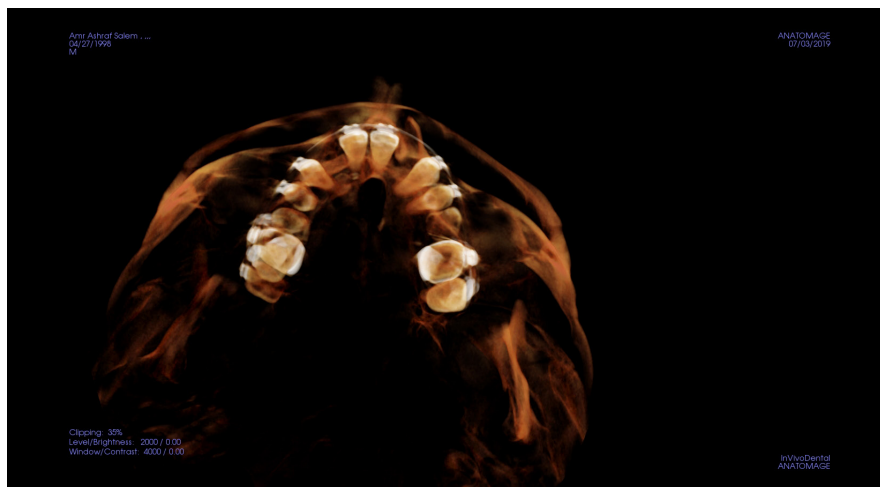


FIGURE 18 Preclinical axial occlusal.

palate.³¹ Furthermore, 55% of the maxillary central incisors in 129 Swedish children, who had been born with non-syndromic cleft lip and/ or palate (CLP) were rotated, especially in patients with a maxillary lateral incisor congenitally missing.³² The surgeon usually waits for maxillary expansion and correction of rotated incisors

prior to alveolar grafting. However, prematurely rotating maxillary central incisors with brackets and wires jeopardize their periodontal support and prove inefficient. Hence, we created the F-Quad helix. The aim was to rotate the central incisor around its long axis without tipping it. Maxillary central incisor rotation took only

FIGURE 19 Post clinical axial occlusal.



6 months, followed by alveolar grafting. After 3 months of consolidation after grafting, we achieved leveling and alignment of both arches. In a CBCT study, maxillary canine impaction and maxillary ectopic canine eruption were observed more commonly in the cleft side (35.7%) than in the normal side (14.3%) in 28 patients with UCLP group.³³

5 | CONCLUSIONS

A method for simultaneous maxillary expansion and tooth alignment in patients with unilateral cleft lip and /or palate has been described. The extension arms of the F-quad helix allowed the use of a couple to align a 90-degrees rotated maxillary central incisor during maxillary expansion. Moreover, these extension arms also aligned a palatally ectopic maxillary canine.

AUTHOR CONTRIBUTIONS

Fady Fahim: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; validation; visualization; writing – original draft. **Dr Ahmed Othman M.Sc.:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; validation; visualization; writing – original draft. **Constantin von See:** Funding acquisition; resources; supervision; validation; writing – review and editing.

ACKNOWLEDGMENTS

Not applicable.

FUNDING INFORMATION

This research project received APC from Danube Private University, Austria.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the manuscript of this article.

ETHICS STATEMENT

The approval was obtained from Cairo University.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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How to cite this article: Fahim FH, Othman A, von See C. F-quad helix for simultaneous maxillary expansion and tooth alignment in patients with unilateral cleft lip and/or palate. *Clin Case Rep.* 2023;11:e7572. doi:[10.1002/ccr3.7572](https://doi.org/10.1002/ccr3.7572)