

Orthodontic Interceptive Appliance for Unilateral Posterior Crossbite in Mixed Dentition: A Case Report

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Abstract: ***Introduction:** Unilateral posterior crossbite is a type of malocclusion that often occurs at the deciduous and mixed dentition stages. Researches indicate that 0-9% of posterior crossbite can be corrected by itself in mixed dentition, so early intervention is important. The quad-helix orthodontic appliance is a solution to widen the maxilla in the skeletal and dental transverse direction to produce orthopedic and orthodontic movements. The utilization of the growth and development phases can accelerate the success of the treatment. **Objective:** To describe a unilateral posterior crossbite case using a quad-helix orthodontic appliance in mixed dental stages. **Case report:** A 7-year-old female patient complaining of an irregular arrangement of teeth with habits of long-term pacifier sucking and supporting the left chin. There was a diagnosis of Angle class I skeletal malocclusion and class II dental subdivision, accompanied by anterior and posterior crossbite shifting the mandibular midline 4 mm to left and facial asymmetry. Quad-helix treatment was carried out for 6 months with a retention phase for 3 months and continued with a fixed orthodontic phase. Unilateral posterior crossbite correction was achieved. **Conclusion:** A quad-helix orthodontic appliance can be an alternative for early treatment for unilateral posterior crossbite in mixed dentition.*

Keywords: unilateral posterior crossbite, quad-helix, mixed teeth, orthodontic interceptive

1. Introduction

Unilateral posterior crossbite is a common type of malocclusion among children. A study in Brazil in 2016 on 3-6 years old children shows that the prevalence of unilateral posterior crossbite is 11.6% which were 6.8% on the right and 4.8% on the left [1]. The probability of posterior crossbite correcting itself is very small without any intervention (0-9%) [2,3]. This is why early intervention to correct posterior crossbite is very important.

Posterior crossbite is a condition in which one or more posterior teeth (canine to the second molar) are crooked toward buccolingual or buccopalatal with one of more teeth facing different directions during central occlusion [2-4]. Most posterior crossbite cases are unilateral accompanied by shifted mandibular midline [5,6]. Lindner and Modeer claim that among 76 children with posterior crossbites of the deciduous teeth, 48% have 2.1-3.0 mm lateral shifting toward the crossbite side in the mandibula [2]. Nearly 80% to 97% of unilateral posterior crossbite cases have functional property.^{2,3,7}

The etiology of posterior crossbite is affected by hereditary and local factors. The main cause is dental-skeletal-neuromuscular condition.² Other causes are non-nutritive sucking, mouth breathing due to airway obstruction, less than 6 months of breast feeding, bottle feeding, neonatal intubation, premature loss, malposition of maxilla and supporting one side of chin.^{5,6,8}

Researches show that unilateral posterior crossbite can be corrected by expansion treatment to prevent skeletal asymmetry in adulthood.^{1,5} Maxillary expansion appliance is installed after treatment of occlusion that often happens to deciduous canine and can correct unilateral posterior

crossbite by 30-50%.^{3,5} The recommended time for installing the appliance is after the eruption of permanent molar.⁵ Slow maxillary expansion (SME) is suggested for slow expansion⁹⁻¹¹, because during the early stage of mixed dentition, less power is required to produce suture expansion.²

One of SME appliances is Quad-helix, which can work with a combination of dental and skeletal movements. The range of suture expansion varies from 0.4 to 1.1 mm per week. Skeletal change is estimated to be 16%-30% and varies by age. Excessive expansion is performed to anticipate relapse. Average retention period of 3 months is performed after expansion until orthodontic fixed appliance stage.^{2,9-11}

Quad-helix consists of four helix, palatal bars and molar band, made of 0.038 inch (0.975 mm) stainless steel wire soldered to the molar band.¹² The length of palatal bar can be adjusted to the crossbite teeth or constricted palatal arch. The appliance is held by molar band cemented using glass ionomer cement.^{9,13,14} Helix bar activation can push posterior and anterior maxillaries laterally by translating alveolar bone and molar tooth to combined buccal direction using molar torque control, mid-palatal suture expansion and molar translation to buccal, palatal suture expansion and combination of two or more of those movements.^{15,16}

The advantages of this appliance are better retention, comfortable, not easily broken, large expansion range, orthopedic effect, periodic expansion, little relapse, able to stop bad habit such as sucking thumb, can be combined with fixed appliance, able to produce molar rotation, not affecting speech and cost effectiveness. The disadvantages of this appliance is producing limited skeletal change and soft tissue ulceration.^{9,17} The objective of this case report is

describing a case of unilateral posterior crossbite with quad-helix consists of four helix, palatal bars and molar band, made of 0.038 inch (0.975 mm) stainless steel wire soldered to the molar band.¹²The length of palatal bar can be adjusted to the crossbite teeth or constricted palatal arch. The appliance is held by molar band cemented using glass ionomer cement.^{9,13,14}Helix bar activation can push posterior and anterior maxillaries laterally by translating alveolar bone and molar tooth to combined buccal direction using molar torque control, mid-palatal suture expansion and molar translation to buccal, palatal suture expansion and combination of two or more of those movements.^{15,16}

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2. Case Report

A 7 years old female patient went to Pediatric Dentistry Polyclinic of the Dental Hospital of Padjadjaran University with her parents, complaining that the upper teeth grew crooked and tilted jaw. the patient and her parents requested tidying her teeth. The anamnesis data shows good general health, no history of systemic disease, congenital disorder, and dental trauma. The patient had a habit of sucking pacifier since she was a baby until she was 6 years old, and supporting the left chin.

Facial proportion and extraoral analysis showed symmetrical vertical and horizontal facial proportions, mesocephalic facial type, flat facial profile, normal lip relation, and positive lip seal (figure1). Physical examination result showed even head position, straight body posture, and uneven shoulders.

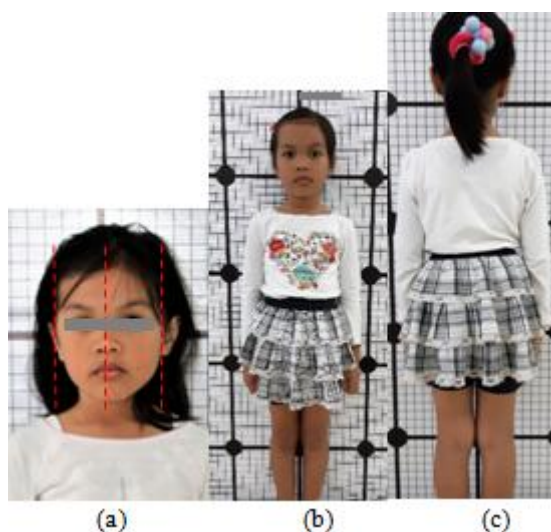


Figure 1: (a) Facial profile, body posture (b) front, (c) back

helix orthodontic appliance in mixed dentition stage. Intraoral examination showed early phase of mixed dentition, moderate oral hygiene, no labial and lingual frenulum disorder. Relation of left molar was Angle class II and right was Angle class I. Midline shifted to the left by around 4mm (figure2), over jet 3 mm, overbite 3-4 mm, crossbite of teeth 22, 63, 64, 65, 26, normal right and left curves of Spee. Panoramic and cephalometric radiographic examinations showed class I skeletal malocclusion and CS 1 skeletal maturation prediction (figure3).



Figure 2: Patient Intra Oral Examination. (a) Front, (b) left, (c) right.

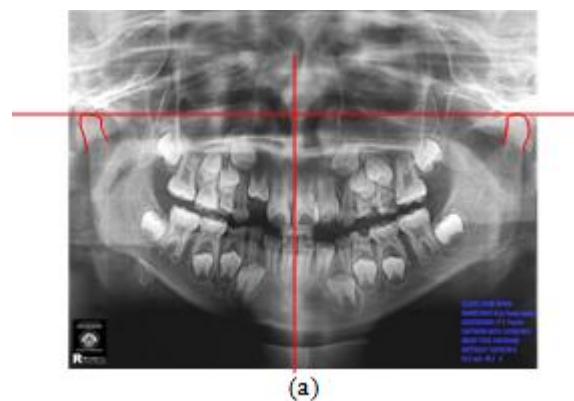


Figure 3: Radiography view (a) Panoramic, (b) Cephalometric

Study model analysis based on Moyers showed shortage of space in the upper jaw by 3.7 mm in right region and 2.5 mm in left region. Tanaka-Johnston Analysis showed shortage of space in the upper jaw by 5.5 mm in right region and 3.5 mm in left region.

Based on anamnesis, extra oral and intra oral examinations, panoramic radiography, cephalometric radiography and model analysis, class I skeletal malocclusion and Angle class II dental subdivision were diagnosed, along with cross bite of teeth 22, 63, 64, 65, and 26, 4 mm shift of lower jaw midline to the left and facial asymmetry. The patient's malocclusion etiology was different length of dental arch from length of dental arch, unequal upper and lower jaw growth and development, and pacifier sucking and supporting left chin.

3. Case Implementation

The treatment started with dental and oral hygiene education (DHE), oral prophylaxis, scaling and some conservation treatments and topical fluorine application. The treatment was done in two stages, i.e. orthopedic and orthodontic phases. Orthodontic stage includes installing quad-helix on the upper jaw (figure 4) to correct unilateral posterior crossbite and get space by expanding maxilla, followed by supportive stage. The second stage was installing orthodontic permanent appliance after correcting permanent first molar crossbite and increasing arch. Informed consent was given for the treatment and is published in the case report.

One week after the insertion, quad-helix activation was performed every 3-4 weeks. Activation was performed unilaterally by turning the left posterior loop to widen the loop bar. In the fourth month, there was ulceration on the palatal mucosa so that the quad-helix was temporarily removed for 1 week and soft tissue treatment was performed (figure 4). After using quad-helix for 4 months, unilateral posterior crossbite started to be corrected. In the fifth month, unilateral posterior crossbite was corrected. The supportive stage was performed for 3 months without activation.



(a)



(b)

Figure 4: (a) Quad-helix. Insertion on 14 Dec. 2018. (b) Ulceration of palatal mucosa soft tissues on 26 April 2019.

After quad-helix was removed, orthodontic phase was performed using 2x4 orthodontic permanent appliance using NiTi thermal wire. Regular orthodontic checkup was performed every 3-4 weeks. After 3 months of orthodontic

permanent appliance treatment, dental malposition improved and RB midline shifting declined. Before and after treatment photos are presented in figure 5.

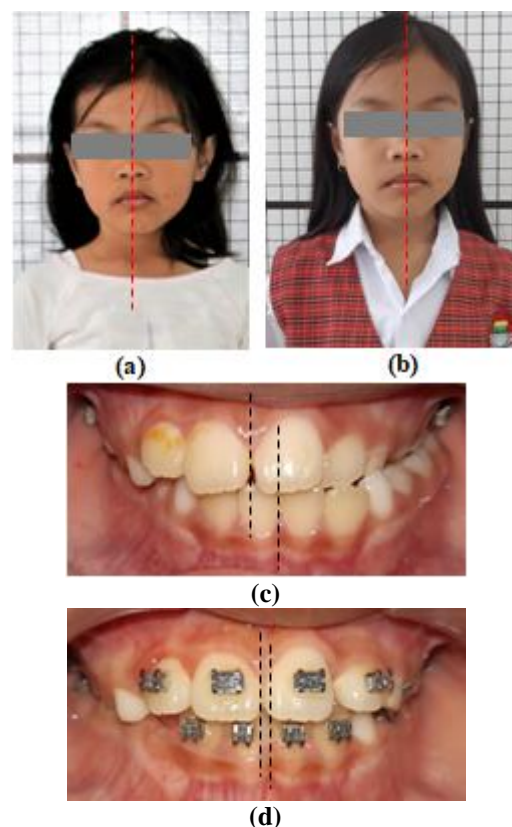


Figure 5: (a) Profile before quad helix treatment, (b) profile after treatment, facial asymmetry has improved. (c) During occlusion, front look before treatment, (d) after quad helix treatment, showing mandibular shifting correction to the left of the crossbite.

4. Discussion

Posterior crossbite is a type of malocclusion which often occurs among children in deciduous and mixed dentition stages.¹⁸ Most posterior crossbite cases are unilateral accompanied by shifting mandibular midline^{5,6} and characterized by asymmetric maxillary and mandibular dental arches.³

Intra oral clinical examination of this case found "double bite", which is unilateral posterior crossbite in maximum intercuspation, but there was contact on deciduous canine when mandible was guided into central occlusion.¹ This condition is also referred to as functional posterior crossbite. Researches indicate that 97% of unilateral posterior are functional.^{2,3,7} The crossbite side in functional crossbite often shows Angle class II molar and the non-crossbite side shows class I due to rotation when closing the mandible.^{1,3} Pinto (2001) states functional unilateral posterior crossbite causes significant skeletal mandibular asymmetry at 7-10 years old. Asymmetry may be related with bigger temporal muscle activities in the crossbite side and mandibular ramus adaptation.¹⁹

One of the malocclusion etiologies of the patient is long term pacifier sucking from the age of 2 months old to 6-year-

old. Melink et al. (2010) state that there is relation between pacifier sucking habit and unilateral posterior crossbite. The longer the pacifier sucking, the higher the chance of unilateral posterior crossbite occurring (odds ratio 21.9 timer higher).²⁰ Pacifier sucking causes imbalance between tongue, cheek, and lip muscles. Lip and cheek activities on the buccal surface of maxilla and alveolar bone become greater due to lack of resistance from the buccal area. The permanent consequence of the damage is narrow and short maxilla. Narrow maxilla forces the tongue to remain on the bottom of the oral cavity, causing unilateral posterior crossbite.^{1,5,20}

The patient is in the developmental age with CS 1 skeletal growth. Kennedy (2005) argues that to produce maxillary suture expansion during deciduous and mixed dentition stages (under 8 year) less power is required.² Bell and Kiebach (2014) states the importance of early treatment because it can produce more symmetrical and stable treatment due to balance inneuromuscular pattern.¹ Treatment becomes simpler, shorter and more tolerant to the physiology of tissue structure, so it's more effective and efficient to do it in deciduous and mixed dentition phases.^{1,10,14}

Quad-helix is one of slow maxillary expansion (SME) type maxillary expansion appliance that gives more continuous action dentally and skeletally.^{9,16} Frank (1982) states that the movements produced in quad-helix treatment are predominantly orthodontic with 6:1 ratio with skeletal movement.¹⁷ The advantages of quad-helix are good retention, wide working range, orthopedic effect, differential expansion, solving bad habit, molar rotation effect, little patient complaint, hard to break and little relapse.^{2,9-11}

Maxillary expansion treatment progress can be seen through study model analysis. A possible evaluation is comparing the length of dental arch, intercanine distance, intermolar distance, distance of crossbite area and non-crossbite area, palate depth, treatment before and after (table 1).^{3,13,14}

Table 1: Progress Analysis of Quad-helix Treatment

Aspect	Before (mm)	After (mm)	Research (mm)
Length of Dental Arch	84.5	88	N = 99 (+4.3) ¹²
Intermolar Distance	50	54	5.6 + 2.7 (SD) ¹⁴
Intercanine Distance	32	36	4.9 + 3.9 (SD) ¹⁴
Palate Depth	15	16	1 + 1.2 (SD) ²¹
Mandibular midline shifting	To the left 4	To the left 1.5	

Increased length of dental arch might have happened due to the work mechanism of quad-helix that pushed posterior and anterior teeth to lateral direction, producing space and improvement of the shape of constricted maxillary arch.^{13,16,17} Increased intermolar distance might have happened due to activation of quad-helix in the anterior loop and the wire connected to the band on molar that would produce thrust against posterior tooth, in this case molar to lateral direction.^{15,16} Increased intercanine distance was the result of activation of distal loop that pushed anterior maxillary region to the lateral direction by translating alveolar bone.²⁴ Increased palate depth by 1 mm was consistent with the study by Ladner and Muhl (1995) that

states that there is 1.0 mm (SD ± 1.2 mm) increased palate depth after treatment using quad helix due increased dentoalveolar height.²¹

Mandibular midline shifting also changed after treatment. Some studies show that 17% of unilateral posterior crossbite cases have mandibular midline shifting toward the crossbite side by over 4 mm.¹ Pinto (2001) states that functional crossbite treatment during development quickly remove postural and skeletal asymmetry.¹⁹

Unilateral posterior crossbite treatment using quad-helix in this case produced good progress. Bell and Kiebach (2014) suggest using quad-helix for unilateral posterior crossbite in mixed dentition phase.¹ This appliance was tolerated well by the patient although ulceration due to right anterior loop occurred, but treated successfully. This is one of the disadvantages of quad-helix, i.e. irritating soft tissues.^{9,11,16} Quad-helix wasn't damaged, didn't cause difficulty talking, or oral health issue and masticatory disorder. The ability to expand to anterior and posterior directions of quad-helix produced expansion, so that unilateral posterior crossbite was corrected. Orthodontic permanent stage is the continuation of unilateral posterior crossbite treatment using SME expansion appliance after molar occlusion into Angle class 1. Treatment was performed until the arch increased, there was room to correct dental malposition, there was improved midline and facial asymmetry.

5. Conclusion

Quad-helix orthodontic appliance can be an option for early intervention treatment for unilateral posterior crossbite in mixed dentition period.

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