AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

Expansion Changes By Removable Quad Helix Appliance On Constricted Maxilla In Growing Patients

Hawa Shoaib, Ahmed Hafez, Maher Fouda

Department of Orthodontics, Faculty of Dentistry, Mansoura University, Egypt.

Address For Correspondence: Hawa Shoaib, Department of Orthodontics, Faculty of Dentistry, Mansoura University, Egypt.
E-mail: hawaali60@gmail .com

ARTICLE INFO

Article history:
Received 18 June 2017
Accepted 28 July 2017
Available online 20 August 2017

Keywords:
Constricted maxillary arch, expansion, cross bite, growing patients, quad helix appliance

ABSTRACT

Objective: to evaluate expansion changes by removable Quad helix appliance on cephalometric measurements in growing patients Materials and methods: the present prospective clinical study consisted of fourteen subjects (7 girls and 7 boys) with cross bite due to constricted maxillary arch. Cases were selected to be treated for 8 months. Results: A significant difference of cephalometric measurements for FMA, S-GO, ANS-Me, and all measurements for cast analysis and postro –anterior cephalometric measurements. Conclusion: Treatment of Growing patients with cross bite by quad helix appliance was effective due to expansion of maxilla and correcting cross bite malocclusion.

INTRODUCTION

Many patients have a noticeable cross bite of the buccal segments when their occlusion is in maximum inter cuspation. (Binder, R.E., 2004)

Posterior crossbite is one of the most common malocclusions in the young patients. (Petrén, S., *et al*., 2013) Posterior crossbite is defined as any abnormal buccolingual relation between opposing molars, premolars or both in centric occlusion. (Arvinth, R., *et al*., 2016)

The etiology of posterior crossbite can include any combination of dental, skeletal, and neuromuscular functional components, sucking habit obstruction of the upper airway, and certain swallowing patterns have been identified as etiologic factors of the posterior crossbite. (Toroglu, M.S., *et al*., 2002)

The early correction of posterior cross-bites requiring maxillary expansion has been advocated to redirect the developing teeth into more normal positions, eliminate untoward temporomandibular joint positions and mandibular closure patterns, and make beneficial dentoskeletal changes during growth periods involving a reduced treatment complexity and time. (Bell, A., 1982)

Various modes of posterior crossbite correction have been suggested, including rapid maxillary expansion, slow expansion with the quad-helix and removable expansion plates.(Petrén, S., L. Bondemark, 2008)

Three expansion treatment modalities are used today: rapid maxillary expansion (RME), slow maxillary expansion (SME) and surgically assisted maxillary expansion, Practitioners select treatment appliances based on their personal experiences and on the patient's age and malocclusion. (Argawal, A., 2010)

Animal studies suggest that SME (slow maxillary expansion) maintains sutural integrity during expansion, producing a more stable result than RME (rapid maxillary expansion). (Wong, C.A., *et al*., 2011)

Orthodontic expansion can cause increases in archperimeter and the correction of dental crowding and constricted maxilla. (Germane, N., *et al*., 1991)

Slow expansion by The quad-helix produces forces be- tween 180 and 667 g, depending on the material

To Cite This Article: Hawa Shoaib, Ahmed Hafez, Maher Fouda Expansion changes by removable quad helix appliance on constricted maxilla in growing patients ***Aust. J. Basic & Appl. Sci.,*** *11(11): 171-177, 2017*

used, and the length and the size of the wire. (Corbridge, J.K., *et al*., 2011)

The main advantages offered by the quad-helix appliance are that child or parent compliance with the treatment is not strictly necessary, and that the patient enjoys greater comfort and better adaptation. (Vizzotto, M.B., *et al*., 2008)

Quad helix delivers a constant physiologic force until the required expansion is obtained. (Marzban, R., 1999)

MATERIAL AND METHODS

The sample of this study was consisted of fourteen patients, each enrolled patient had the procedures explained, their questions answered and a written consent was signed by the patients' guardians. All patients were selected From the clinic of orthodontics department, faculty of dentistry, Mansoura University according to following criteria:

- Constricted maxillary arch.
- Age ranged from 6-12 years old.
- Fully erupted maxillary frist permanent molar.
- Free from any congenital anomalies or systemic disease that might have an influence on tooth movement.
- Good oral hygiene

The Quad Helix has 4 spiral helicoidal bends, two on the anterior zone, which must descend from the bridge to the palate, and the other two are located slightly behind the molar band, to allow rotation and molar expansion.The Qued helix appliance removable ready made 0.9 mm MIA (Mobile intra oral arch system) inserted in the palatal sheaths of the band molar (fig 1 a b).

The Qued helix appliance activation was activated with three prong plire outside of patient mouth. verification of activation amount was by inserting one retention loop and observing the relationship of the other retention loop to its sheath, repeated on opposite side to confirm was be done.

- Activation the posterior helical loops were move the free wires buccally.
- Activation the anterior helical loops were move the molar bands buccally.

New activations was be posted on 40 – 40 day period ; on majority of cases the activation were not exceed 1- 2 mm in order to keep case under control. the arch arms contacts all posterior teeth, the contacts was close to but not touched the soft tissue at the cervical margin.

Patients were appointed every week for evaluation and instructed to clean the appliance after every meals daily by tooth brush and mouth wash and call us if any emergency was happened. When the palatal cusp tips of the maxillary first molars were in contact with the corresponding buccal cusps of the mandibular first molars, expansion was rendered complete and post expansion records were obtained.

The same appliance was left in place as a retainer for 3-4 months during leveling and alignment (Fig 2 and 3).

Each patient had their panoramic, lateral and postero-anterior (PA) cephalometric x-rays before and just after the expansion. Hand wrist radiocentegraphy was taken only before treatment for growth and maturity indication (4).

Lateral and PA cephalometric radiographs were performed in a standardized fashion by the same technician. All cephalometric radiographs were hand traced by the same examiner.

Skeletal and dental changes of the Quad helix appliance were evaluated through radiography and study models. (Table 1, 2, 3)

Definite points on the dental casts obtained before and immediately after expansion and were measured using a digital caliper.

Data analysis and statistics:

The distributions of quantitative variables Cephalometrics (lateral and postero-anterior) and dental cast data were tested for normality. Significance of the obtained results was judged at the 5% level. Paired t-test was used for normally quantitative variables, to compare between pre and post-expansion (T1 and T2) respectively.

Results:

All included cases successfully achieved the intended expansion in 3to 4 months. All appliances were fitted in patient mouth and remained so after the post expansion records were taken and during the retention phase of 4 months. The values of the lateral cephalometric variables, before and immediately after expansion, (Table 1), showed no significant increase in the means of SNA (0.11), ANB (0.47); with no apparent alteration in the sagittal position of the mandibular base; SNB: (0.54). Wilcoxon ranks test was used to obtain Wits appraisal which recorded a significant increase (1.26).

The vertical behavior of the apical bases immediately after expansion showed an increase in the means of variables FMA (1.71), this change, however, were statistically significant $p < 0.05$.

An increase in the means of variables of facial height: ANS-Me (1.87 mm), S-Go (1.39 mm) was noted., this increase was statistically significant for ANS-Me and S-Go.

The measured dental cephalometric variables, U1-SN (0.54), L1-MP (0.44) and inter-incisal angle (0.48) increased insignificantly after expansion, $p > 0.05$.

PA cepahlometric measurements revealed significant increases in the skeletal measurements (facial, nasal and maxillary) transverse dimensions and no significant increase in (mandible) transverse dimension.

Skeletal FTD (0.95), NTD (0.96), MXTD (1.43), were p value < 0.05 .and MDTD (0.68) p value > 0.05 (Table 2)

Table 1: Lateral Cephalometric findings before treatment (T1), after expansion (T2) and the mean difference of each variable before and after expansion (T2-T1).

Measurements	Pre-expansion (T1)		Post- expansion (T2)		mean		
	Mean	SD	Mean	SD		SD	P values
Anteroposterior							
SNA	79.2100	3.23833	79.3289	3.48520	.11889	1.10842	.756
SNB	75.8122	3.43370	75.3411	3.41299	.47111	1.14021	.250
ANB	3.3989	2.42623	3.9389	2.85478	.54000	.92961	.120
Vertical							
FMA	25.6800	5.22067	27.3967	5.28567	1.71667	.80006	.000 *
SN-OCC	22.1422	3.46172	20.9956	3.63353	1.14667	2.28158	.170
SN-GOGN	37.0122	3.72261	37.2422	4.22120	.23000	.64973	.319
Dental							
U1-SN	104.6478	6.36843	105.1956	7.50904	.54778	2.26950	.490
L1-MP	86.7667	4.05959	87.2122	4.24436	.44556	1.99971	.523
U1-L1	129.3411	7.49622	128.8600	8.25542	.48111	1.90279	.470
U1-NA	25.4944	5.19434	25.6044	6.36238	11000	2.65264	.904
L1-NB	20.7044	6.68186	21.8822	5.03534	1.17778	3.20790	.303
Facial height (mm)							
S-GO	64.6189	3.39372	66.0178	3.93378	1.39889	1.48655	.022 *
ANS-ME	60.1489	3.54048	62.0189	3.86228	1.87000	1.09694	.001 *

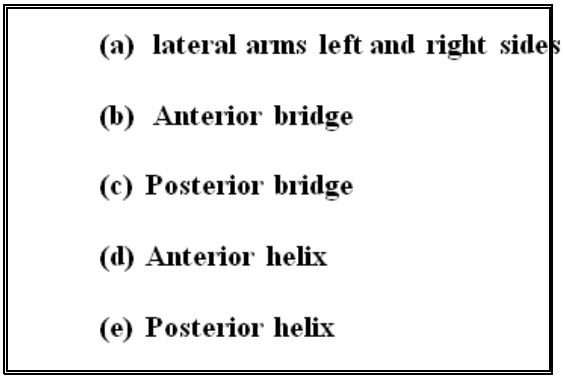
t: Paired t-test \ *: Statistically significant at $p \leq 0.05$

Table 2: Posterior-Anterior Cephalometric findings before treatment (T1), after expansion (T2) and the mean difference of each variable before and after expansion (T2-T1).

Measurements (mm)	Pre-expansion (T1)		Post- expansion (T2)		mean		
	Mean	SD	Mean	SD		SD	P values
SKELETAL							
FTD1	113.8356	6.38455	114.7933	6.64616	.95778	.38438	.000 *
NTD1	21.1111	1.47599	22.0800	1.60749	.96889	.65745	.002 *
MXTD	60.0733	3.03129	61.5111	3.03146	1.43778	1.01301	.003 *
MDTD1	76.4989	3.49728	77.1878	3.38089	.68889	1.32188	.157

Table 3: Study Model analysis before treatment (T1), after expansion (T2) and the mean difference of each variable before and after aexpansion (T2-T1).

Measurements (mm)	Pre-expansion (T1)		Post- expansion (T2)		mean		
	MEAN	SD	Mean	SD		SD	P values
OB	1.944	2.1858	1.389	1.9167	.5556	.6821	.040
MAP	75.2333	3.81994	82.1567	4.35834	6.92333	4.44916	.002
WPR	32.1356	3.57918	38.9100	4.70480	6.77444	3.57015	.000
WMR	40.9889	3.82617	51.0922	3.79779	10.10333	4.88723	.000



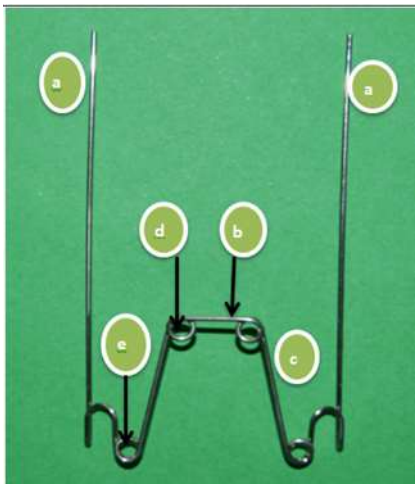


Fig. 1: The Quad Helix Expander

Fig. 2: Case presented before expansion.

Fig. 3(a): The Quad Helix inserted in palatal sheath and the arch arms contacts all posterior teeth.

Fig. 3(b): Case presented after expansion.

Discussion:

The early correction of posterior cross-bites requiring maxillary expansion has been advocated to redirect the developing teeth into more normal positions, eliminate untoward temporomandibular joint positions and mandibular closure patterns, and make beneficial dento skeletal changes during growth periods involving a reduced treatment complexity and time. (Bell, A., 1982; Bell, R a., *et al*., 1981)

The Quad Helix is one of the most versatile appliances that can be used in the early mixed dentition, because it is easy to use and well tolerated by patients. (Cozza, P., *et al*., 2000)

Angular measurments for the sagittal skeletal dimensions of the present work **(*Table* 1)** were not significant changes for the sample before and after treatment for SNA . No change significance in A point position was detected in current study. Those finding were in agreement with other different expansion studies. (Sandikçioğlu, M., S. Hazar, 1997; Ramoglu, S.I., Z. Sari, 2009; Gabriel, O., P. Montes, 1995)

Present study agree with Piskai *et al* (2016) that FMA angle showed significant increase change (1.7^{o}). This change could be indicating a tendency to ward vertical growth pattern , and the major contributors to the vertical increases were the FMA angle, ANS-Me. (Saadia, M., M.S.E. Torres, 2001) Where S-GO

(1.4) and ANS –Me (1.8), SNA- ME, S- GO measurements showed significance increase, and this increased due to tipping of the first molars buccally and extrusion of palatal cusps , bite opening increased lower anterior facial height, increased in the skeletal vertical dimensions during expansion treatment period. These results consisted with that obtained by others. (Conroy-piskai, C., *et al*., 2016; Rossi, M De., *et al*., 2010; Vergata, T., T. Vergata, 2001).

A number of analysis of PA cephalographs emerged, depends on the linear measurements. (Huertas, D., *et al*., 2001) Regarding the transverse changes **(Table 2)**

MXTD the maxillary bases showed 1.44 mm increase in the width were statistically significant. This increase showed amount of skeletal expansion produced by the appliance in agreement with several previous researchers Brosh *et al* (Orthopedics, D., *et al*., 1998), Olmez (2007), Sari *et al*, Karman (2002), Cotton (1978), Chung and Font (2004), Machado *et al* (2006), Marzban and Nanda (1999), Asanza *et al* (1997)

FTD was significant increase due to maxillary expansion and postero anterior radiographs revealed an skeletal increase the lateral dimension in nasal cavity this increase was stable after expansion . These results was agreement with these authers. (Sari, Z., *et al*., Chung, C.H., *et al*., 2004; Garland, H., W. Warren, 1976).

In the present study, mouth breathing patients suffering from uni – or bilateral cross bite and the use of QH appliance promoting expansion the maxilla to correct posterior cross bite.

FTD was significant increase with 1 mm this denote the amount of skeletal expansion produced by the appliance. Disagree results were reported by Christopher *et al* (Cameron, C.G., *et al*., 2002), Letizia Perillo *et al* (2014).

Concerning the transverse expansion changes by study cast measurements (Table 3) the WPR width at pre molar region increased significantly after expansion averaged 6.8mm While the amount of molar width expansion WMR averaged 9.1 mm.

Inter premolar, inter molar changes in width display the total amount of alveolar and dental expansion produced by QH in consistent with Corbridge *et al*., (2011), Karman (2002), Marzeban and Nanda (1999), Raju *et al*. (2014)

The Maxillary arch perimeters MAP (Table 3) increased significantly after expansion with average 6.9 mm for 9.1 mm inter molar width in ratio 0.7 mm for every 1 mm of inter molar expansion; this result due to expansion was greater in the posterior than in the anterior region of the maxilla. (Ladner, P.T., Z.F. Muhl, 1995) Nearly similar results was found by Akkaya (1999) was 0.7: 1mm, Bell (1982), Wong *et al*., (2011) While Berlocher *et al* (1980) reported 1mm increase for every 1mm of inter molar expansion.

Over bite (Table 3) decreased significantly due to the opening of mandibular plane angle by QH maxillary Expansion procedure. That results was in agreement with Bell (1982), Karman (2002), Hass (1980), Lander *et al* (1995).

Conclusion:

1- The QH appliance was an effective fixed invisible non compliance expander appliance that expanded the maxillary arch in average period of 4-6 months.

2- The average rate of dental maxillary expansion at first molar by QH expander appliance was 2.5 mm / month.

3- The maxillary bases MXTD from posteroanterior cephalograph was increased 1.44 in width, nasal aperature 0.98 mm.

4- The QH appliances produced 0.7 mm increase in arch perimeter for every increase of 1mm in the inter molar distance . 0.9 mm in perimeter for every increase of 1mm in the inter premolar distance.

Contribution Of Knowledge:

The quad-helix appliance developed with a vision to generate low force magnitudes. The inclusion of four helical loops in the design led to increased appliance size and improved the system's flexibility. the patient enjoys greater comfort and better adaptation.

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