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Transverse Skeletal Effects of Hyrax-Type Rapid Maxillary Expansion with or without Laser Biostimulation

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ABSTRACT

Purpose: The aim of this study was to assess the effect of low level laser biostimulation on the transverse changes of maxilla and mandible after rapid maxillary expansion in growing patients. **Subjects and Methods:** Twenty growing patients with posterior teeth in crossbite were included in this study. Patients were randomly divided into two groups. Rapid maxillary expansion had been carried out for all patients. In laser group, laser was applied on mid palatal suture during active expansion and during retention. The control group had no laser with their expansion procedures. Pre-treatment and post-treatment Cone beam computed tomographies were used to compare the changes in skeletal maxillary and mandibular widths. **Results:** The two groups showed an insignificant increase in both inter-jugale distance and bigonial distance. No significant difference was found between the laser group and the control group regarding the amount of change of both bigonial and inter jugale widths. $P \leq 0.05$. **Conclusions:** In both Laser and non-Laser groups, Rapid maxillary expansion in growing patients with posterior crossbite produces insignificant increase in maxillary transverse inter jugale and bigonial widths. Laser application during maxillary expansion has statistically insignificant effect on changes in maxillary interjugale width and mandibular bigonial width.

KEYWORDS

Laser, Expansion,
Hyrax appliance

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INTRODUCTION

Posterior cross bite describes the occlusal relationship when upper posterior teeth are in reverse relation to lower posterior teeth⁽¹⁾. Reversed posterior occlusion can have damaging effect on growth due to deviation in chewing pattern, unequal muscular strain on TMJ⁽²⁾. Posterior crossbite in most of the cases is sign of transverse maxillary deficiency⁽³⁾. So early intervention to eliminate it is always recommended to avoid any hazards⁽⁴⁾.

Management of posterior crossbite involves different modalities. Removal of biting interferences to neutralize the occlusion is one way. Another method is to passively expand arch with appliances including acrylic pads on buccal sides to remove the cheeks pressure from teeth this lead to disturbing the equilibrium of neutral zone that allow teeth arch to get wider⁽⁵⁾. The most popular approach is to actively expand the upper arch by opening of mid palatal suture. Rapid maxillary expansion (RME) means to open the screw two times on each day. The rate of expansion daily is 0.5mm with forces of 10 lb. Overexpansion and relatively long retention period are always required with RME to allow sutural bone filling⁽⁶⁾.

Rapid maxillary expansion is successful procedure in growing patients till adolescence. As the growth continues to adulthood, the success of expansion decreases due to increased bony maturation and sutural closure⁽⁷⁾.

Effects of rapid maxillary expansion have been investigated for long period. The effects include increase in maxillary width, mandible width follows this increase with anterior movement of backward rotation of lower jaw^(8,9). Also the findings of multiple studies revealed increase in nasal width and air way volume and its effect on breathing and air flow which is still controversial issue^(10,11).

Unfortunately maxillary expansion can cause undesired effects on teeth and buccal bone. Decreased thickness of buccal bone, fenestrations,

reduction of alveolar crest height and apical root resorption was also reported^(12,13).

The percent of orthopedic versus dental effects and the percent of desirable versus unwanted side effects of expansion depend on many variables including the age of the patient, the appliance type of anchorage, periodontal condition of anchoring teeth and also duration of retention⁽²⁾.

Low Level Laser has been introduced in dental practice. It has been used for pain reduction and for biostimulatory effects on various tissues that stimulate bone healing and reformation. So in orthodontics this idea of using laser in accelerating tooth movement. Various studies have investigated the effect of Laser application in expansion procedure. There is still controversy about the effect of laser on maxilla expansion whether it can improve healing and increase its stability or not⁽¹⁴⁻¹⁹⁾. Therefore, the aim of our study to assess the effect low level laser biostimulation on the transverse changes of maxilla and mandible after rapid maxillary expansion in growing patients.

SUBJECT AND METHODS

Twenty patients were selected from the orthodontic clinic of Faculty of Dental Medicine for Girls, Al-Azhar University. The patients age was between 8 to 12 years. Patients in this study had certain inclusion and exclusion criteria as following;

Inclusion criteria

1. Patients with unilateral or bilateral posterior cross bite
2. No gender specification, study included males and females
3. Free from systemic disease

Exclusion criteria

1. Syndromic patients or cleft patients
2. Patient under medication affecting metabolism of bone
3. Patients with bad oral hygiene

The study protocol was reviewed and approved by Ethical Committee of Faculty of Dental Medicine for Girls, Al-Azhar University under ethic code of number REC-OR-21-02. Before beginning of treatment protocol of our study detailed explanation of the whole process was given to each patient and his guardian patients and their parents who approved to participate in our study signed informed consents.

The recruited patients were randomly assigned into 2 groups equally

Group A: patients who had done Rapid maxillary expansion with biostimulation with low level laser at mid-palatine suture

Group B :patients who were treated by rapid maxillary expansion without any laser application

Treatment procedure

For diagnostic procedure

Full history dental and medical was reviewed with the patients and his parents for obtaining accurate information.

Clinical examination: Detailed clinical examination was carried out for all patients that involved

- a. Extraoral examination evaluating both frontal and profile views of the patient to assess facial proportions, the shape of face whether mesoprosopic, dolichoprosopic or euryprosopic, the convexity of profile, the lips competency, angle between nose and lips. Also smile evaluation was carried out.
- b. Intraoral examination mainly included examining teeth, occlusion, molar and canine classification. Palatal arch form was also analyzed.

A set of records were taken for each patient at start of treatment including

1. Extraoral photographs for frontal view at rest, frontal view with smile and profile view.

2. Intraoral photographs were taken for front, right side, left side views of teeth in, upper jaw in occlusal view and lower jaw in occlusal view.
3. Orthodontic study model an alginate impression was done and orthodontic cast was poured using stone for orthodontic use.
4. Full face cone beam computed tomography (CBCT)

All participants were treated using bonded Hyrax (figure 1)for rapid maxillary expander which had an acrylic coverage on occlusal plane. Patients were instructed to open the screw two times per day. Expansion was done till overcorrection was achieved (when palatal cusps of upper first molar contacted with buccal cusps of lower molars)^{20,21}. Then the expander was left passively for 6 months for retention.

In group A laser group patients low level laser was applied using (Biolase, *epicx*) InGaAsP Semiconductor diode with a wavelength of 940 ± 10 nm operated according to the manufacturer's recommendation. Low level laser was applied along mid-palatine suture for each patient with total energy level of 140 J/cm^2 .

After 6 months of retention (post-treatment) CBCTs were repeated. Both CBCT images (pre and post) were taken using iCAT CBCT scanner (ISI, USA).Patients were in sitting position with Frankfort horizontal plane parallel to the floor during CBCT imaging in order to standardize the data. Images obtained from CBCT tomographies were converted into DICOM format to be processed on (Invivo version 5.1; Anatomage Dental, San Jose, Calif). Image reconstruction was performed on software to obtain the 3D data. In all three planes (coronal, axial and sagittal), reorientation of patient views was done. Landmarks were identified three dimensionally. Then measurements were obtained on 3D volumetric image. The amount of change (difference between post-treatment and pre-treatment) of bigonial width and interjugale width measurements was measured.



Figure (1) Bonded Hyrax appliance intra-orally

RESULTS

Kolmogorov-Smirnov and Shapiro-Wilko tests were used to assess the normality of preliminary

data distribution. Quantitative data of the study results were presented as mean and standard deviation. Statistical analysis was performed with SPSS 16 Statistics for Windows (NY: IBM Corp).

Comparison between pre and post measurements was performed by using Paired t-test which revealed insignificant difference ($P>0.05$) regarding Interjugale measurements of both laser and non-laser group, also in Bigonial measurements of laser group, as presented in table (1) and figure (2).

Comparison between low level laser & non-laser groups was performed by using independent t-test which revealed insignificant difference ($P>0.05$) regarding Interjugale measurements, and also revealed insignificant difference ($P>0.05$) regarding Bigonial measurements, as presented in table (1).

Table (1) Mean \pm standard deviation of pre & post measurements in laser & non laser groups regarding Interjugale & Biogonial measurements

		Laser		Non-laser		P value
		M	SD	M	SD	
Bigonial measurements	Pre	78.39	1.75	78.06	8.92	0.87
	Post	80.30	1.07	80.09	10.61	0.93
	Difference	1.91	0.70	2.03	1.01	0.65
	P value	0.06		0.64		
Interjugale measurements	Pre	103.68	10.1	97.48	9.55	0.056
	Post	107.31	12.3	100.72	13.13	0.17
	Difference	3.63	0.82	3.24	2.67	0.32
	P value	0.21		0.23		

M; mean

SD; Standard deviation

P; Probability level

*Significantly different ($P < 0.05$).

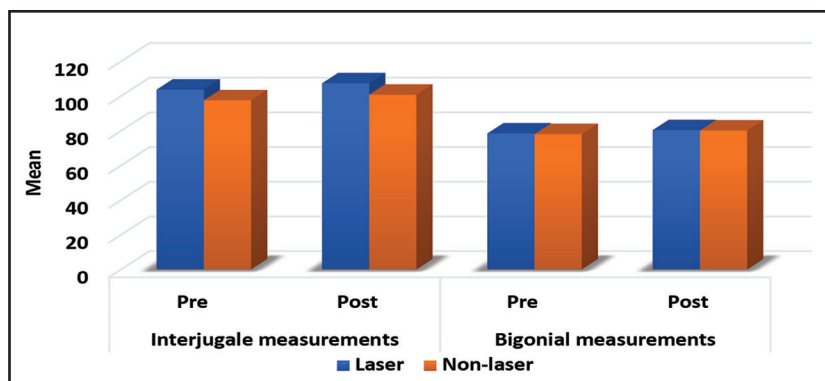


Figure (2) Pre & post measurements in laser & non laser groups regarding Interjugale & Biogonial measurements.

DISCUSSION

Rapid Maxillary expansion is the classical procedure to enlarge the width of upper jaw. Increasing the maxillary transverse size to correct reversed occlusion has better success rate during growing patients so the sample of this study included growing children to guarantee that their midpalatine suture is still immature⁽²²⁾.

The rapid maxillary expansion was carried out in the two arms of our study. Activation of the jackscrew twice daily till over increasing of arch width achieved then retention continued for 6 months. While in intervention group had laser photobiomodulation during whole expansion stages; active opening of the screw and retention phase. CBCTs were used to evaluate the change clearly as it was difficult to correctly locate the landmarks in two dimensional radiographs with low percent of mistakes^(12,23).

Both groups showed insignificant increase in interjugale width due to upper jaw expansion in each group. Also no statistically significant difference between laser group and non-laser group concerning this maxillary width measurement. This was opposite to previous study in 2006 which conducted meta-analysis and found significant increase in skeletal maxillary width represented by interjugale distance but this may be due to evaluation of the effects immediately after active expansion while in our study this was evaluated after retention⁽²⁴⁾.

Regarding skeletal width of lower jaw measuring the bigonial width which is distance between Go points on right and left sides. Both groups showed insignificant increase in mandibular transverse measurement. There was no significance difference when you compare between the laser and non- laser groups. Also previous study examined the effects of laser on effects of RME on 24 patients equally divided into active laser group and no laser group that revealed no significant increase in bi-gonial width in the two groups involved in the research⁽²⁵⁾.

CONCLUSION

The following conclusions can be drawn based on the study's limitations and findings:

1. In both Laser and non-Laser groups, Rapid maxillary expansion in growing patients with crossbite produces statistically insignificant increase in maxillary transverse inter jugale width.
2. In both Laser and non-Laser groups, Rapid maxillary expansion in growing patients with crossbite produces statistically insignificant increase in mandibular transverse bi-gonial width
3. Laser application with Rapid maxillary expansion had no additional statistically insignificant skeletal effect on the changes of inter-jugulae maxillary and bi-gonial mandibular widths.

RECOMMENDATIONS

1. Further trials are recommended to evaluate the effect of laser on rapid maxillary expansion after long term follow up.
2. More clinical trials are needed evaluating patient experience, discomfort, pain and hygiene during bonded maxillary expansion with or without laser application.

CONFLICT OF INTEREST

No conflict of interest by authors during this study.

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