Effect of low level laser therapy during Rapid Maxillary Expansion

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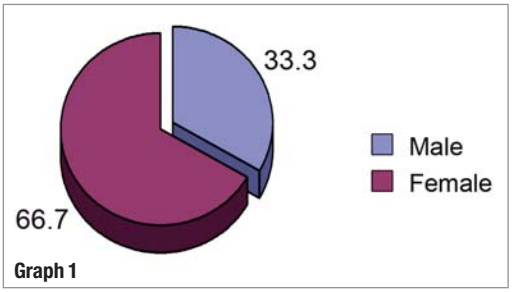
_Introduction

Orthodontic tooth movement is the result of alveolar bone remodeling due to response to mechanical stimulus at the interface with periodontal ligament. Although Wolff's law is generally considered to be a philosophical statement but states the effect that, over time, the mechanical load applied to living bone influences the structure of bone tissue. Bone remodeling can be categorized into two different types:[1,2]

_External bone remodeling, in which the outer geometry of bone tissue adapts due to change in applied forces, while the material properties remain constant;
_Internal bone remodeling in which internal structure of bone tissue remodels due to changes in applied forces, in fact, this type of bone remodeling is related to remodeling of spongy bone in which elasticity parameters of bone tissue change.

Sutures are considered as the growth sites of intramembranous bones[3,4,5,6] in the craniofacial complex. Accordingly, it is fair to assume that if sutures were not present, craniofacial bones might grow only in thickness.

The tissues surrounding sutures, such as the dura mater[7], have a significant effect on sutural patency and growth. Earlier studies have repeatedly confirmed that compressive forces applied across sutures reduce bone deposition and induce bone resorption, while tensional forces increase bone deposition. This response characteristic makes sutures important target areas for orthodontic: orthopedic appliances designed to control vertical and transverse growth of the maxilla, such as palatal expander and cervical, high-pull and protraction headgears.



Graph 1

Graph 1_The percentage of patient distribution according to gender.

The dramatic development of technology in the last decades offers a small but a powerful tool to be used in clinical trials, which is the Laser Beam. LLLT is

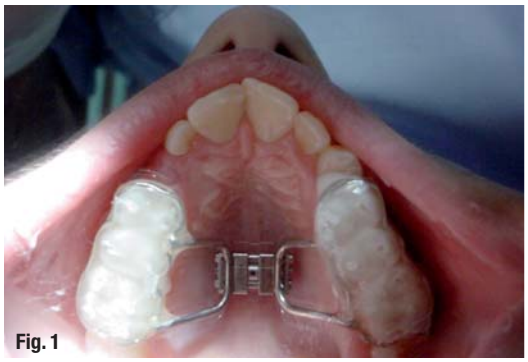


Fig. 1


Fig. 2

Fig. 1_Insertion of RME.
Fig. 2_After expansion.

a type of laser that penetrates deeply into the tissue and affects the cells. This is due to its specific wavelength and low energy level. Treatment with laser therapy is not based on heat development but on photochemical and photobiological effects in cells and tissue. Discomforting pain is a burdensome side effect accompanying orthodontic treatment and/or orthopedic procedure due to force application for movement. Several studies showed an effective pain reduction after different dental treatments using LLLT. Also it has been shown that LLLT is an effective method to prompt bone repair and modeling after surgical procedures.

_Aim of the study

_Our aim is to take advantage of the technological development, in order to increase the bone formation quality, accelerate the formation rate and therefore decreasing the relapse rate.
_Also, we hope to take our patients through a relatively short and happy orthodontic treatment journey, without a discomforting pain.

_Materials and Methods

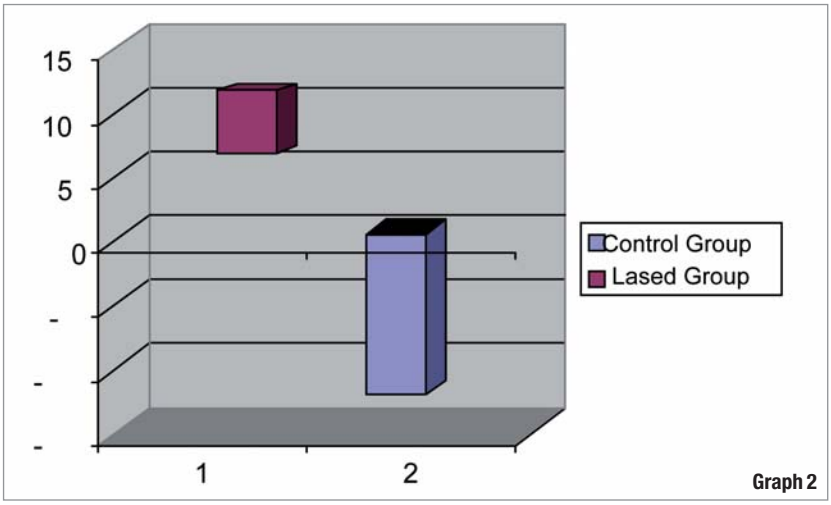
Patient selection
_Twenty patients of both genders participated in the research, and were distributed as following.
_All the patients and their legal guardians were informed of our intent to apply LLLT during orthodontic treatment and they approved to go through it (Consent).

_Orthodontic Treatment

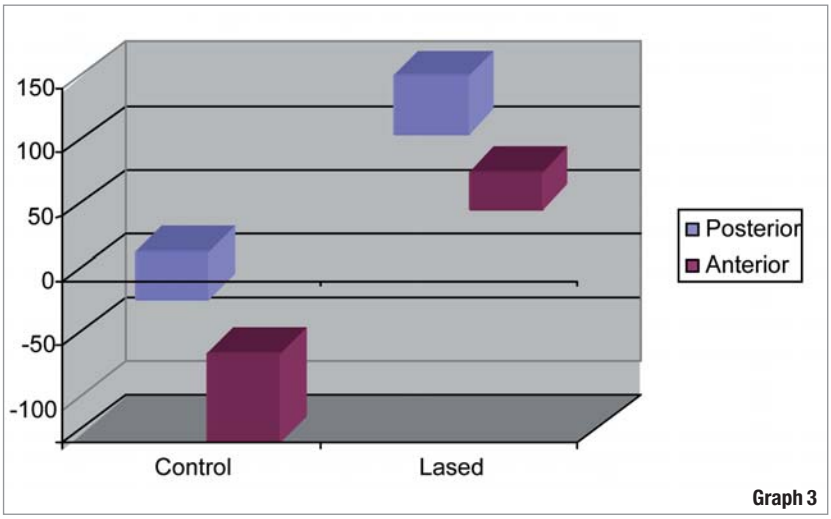
_After thorough clinical examination, the following diagnostic tools were obtained for each patient:

1- X-rays
_A-Panoramic view.
_B-Lateral Cephalometric View.
_C-Antero-Posterior view.
_D-Upper maxillary CT scan with 3 mm sections thickness.
_2-Appropriate Photographs.
_3-Model cast.
_In addition, the followings were taken at the end of the expansion period:

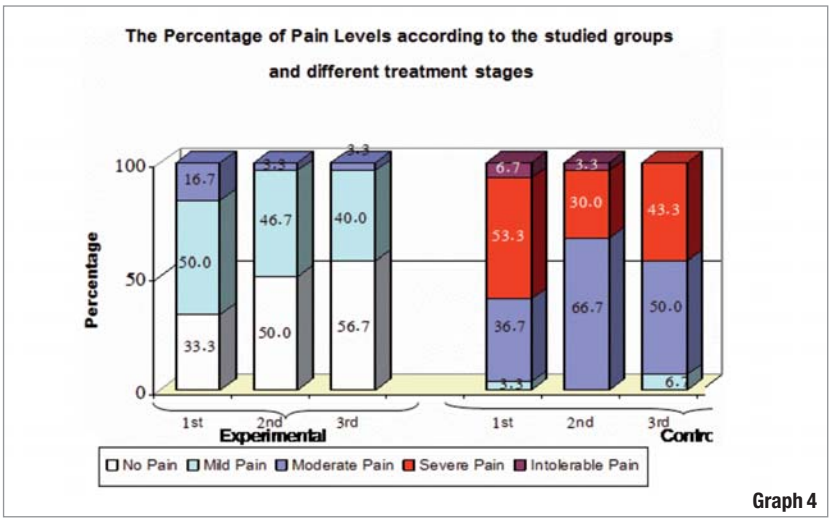
1- X-rays
_A-Upper maxillary CT scan with 3 mm sections thickness.
_B-Antero-Posterior view
_The treatment plan for these patient included Rapid maxillary expansion because of the presence of posterior crossbite or there was not enough space for a complete alignment.



Graph 2



Graph 3



Graph 4

Graphs 2 & 3_Bone density.
Graph. 2: The bone density at the opened suture site was higher in the lased group than control (non-lased) group. Graph. 3: Bone density in the posterior region was higher than the anterior region in both groups. However it was higher in lased than non-lased group.
Graph 4_ Pain Study.
The pain level was higher in the non-lased group throughout the entire treatment.

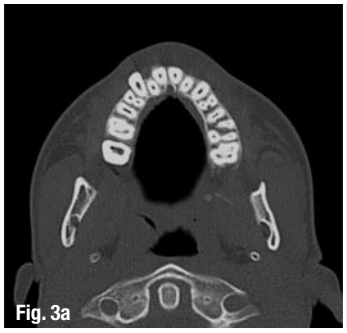


Fig. 3a


Fig. 3b


Fig. 4a


Fig. 4b

Fig. 4a_Before
Fig.4b_After
Fig. 5a_Before
Fig. 5b_After

_The appliance chosen was a Hyrax expander, McNamara type.
_The Hyrax expander was opened twice daily till we reached an overcorrection position (Figs. 1 & 2).
_After one week of achieving the required expansion, Hyrax was removed temporarily to allow taking the CT scan image without artifact effect of the metal (Figs. 3 & 4).

_Laser therapy protocol

a- Selected locations for laser application:
1- Mid palatal Suture (9 J/cm^2).
2- Intermaxillary suture (4 J/cm^2).
3- Zygomaticomaxillary suture (2 J/cm^2) per side.
b- The laser handpiece was held in contact with the tissues and sweeping movements were performed.

_Pain questionnaire

At every visit (after 1mm), every patient was asked about the pain experienced during this period and was recorded and ranked according to the following schedule (Table 1).

In order to study the statistical pain differences, the questionnaire was divided into three phases each phase for a duration of one week.

Degree of Pain	Rank Value
No pain	0
Mild pain	1
Moderate pain	2
Severe pain	3
Intolerable pain	4

Tab. 1

_Results

_Bone density study (Hounsfield unit).
_Pain study.

_Discussion

_Orthodontic tooth movement involves both modeling and remodeling activity that is modulated by systemic factors such as nutrition, metabolic bone diseases, age and drug usage history.
_According to several studies LLLT is an effective tool used to prompt bone repair and modeling post surgery. This is referred to the biostimulation effect of the LLLT.
_This effect had been well studied in the medical field and proven to have an enhancing effect on fibroblast growth.
_Tooth movement and/or orthopedic movement is dependent on a painful and inflammatory adaptation of the alveolar process.
_To relieve such pain, several methods have been used. One of them is to use drugs (NSAIDs). Although these could be effective in relieving pain, they may also reduce the rate of tooth movement.
_The biostimulation effect of the LLLT was also reported to be effective in reducing the pain arising from dental treatment procedures.

_Conclusion

_The (Ga-Al-As) low level laser used in this study is considered to be an effective tool during orthodontic treatment as:

_The rate of bone density raised significantly.
_The pain level reduced significantly.

Editorial note: The literature list can be requested from the editorial office.

_contact laser

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