The effect of low-level laser therapy during rapid maxillary expansion

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Orthodontic tooth movement is the result of alveolar bone remodeling due to a response to mechanical stimulus at the interface with the 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:\textsuperscript{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\textsuperscript{3–6} 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\textsuperscript{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.

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 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.
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**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 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.

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. The appliance chosen was a Hyrax expander, McNamara type.

The Hyrax expander was opened twice daily until 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/cm²).
2) Intermaxillary suture (4 J/cm²).
3) Zygomaticomaxillary suture (2 J/cm²) per side.
B) The laser handpiece was held in contact with the tissues and sweeping movements were performed.

_Pain questionnaire_

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

_Results_

- Bone density study; Graphs 2 and 3 show the Hounsfield units presenting higher levels of bone density in the irradiated group.
- Pain study; in laser group, there was no severe or intolerable pain reported (Graph 4).

_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 remodeling 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.

_CoConclusion_

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: A complete list of references is available from the publisher.