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Is it possible to anchor a tooth with photobiomodulation?

Angela Dominguez

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Abstract

During orthodontic treatment, we can achieve differential movements by using photobiomodulation (PBM) as an adjuvant before applying force. We can expect a greater bone density that initially resists movement while applying PBM to the other teeth to achieve an accelerating effect. The proposed protocol is to use an 810 nm laser at 0.1W power, applying between 4 and 6J per tooth for 22 s on the vestibular and lingual root surfaces, following the axial axis of the tooth. The energy density depends on the tip selected in the instrument. Normal bone remodeling cannot be avoided by applying high doses of PBM. PBM should be applied before orthodontic force to reduce tooth movement. In addition, PBM can be used during force application to teeth that require acceleration to achieve differential movement in orthodontic treatments. The protocol is the same in both scenarios.

Key Words: Photobiomodulation; Orthodontic movement; Diode laser; PBM; Anchorage in orthodontics

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Core Tip: During orthodontic treatment, we can obtain differential movements by using photobiomodulation as an adjuvant before applying force to the teeth we want to use for anchoring, and photobiomodulation-assisted orthodontics to accelerate the movements when force is applied.

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INTRODUCTION

Anchorage in orthodontics, refers to the ability to prevent movement of one or more teeth while another tooth or group of teeth is being moved. To be successful in space closure orthodontic treatment, it's a must to plan the anchorage system protocol. According to this protocol, teeth can be classified as active or reactive/passive units based on their distinct functions during space closure. The active component typically experiences more movement, while the other component provides resistance (anchorage)[1]. To serve as an anchorage unit, PBM can be used as a preparatory therapy in the affected tooth(s).

Photobiomodulation (PBM) using specific wavelengths and parameters is effective for accelerating dental movement[2-5]. However, the application confused the achievement of anchorage or retention of teeth with inhibiting movement through high dosage. This misconception originates from the relationship illustrated in the Arndt-Schulz curve.

The Arndt-Schulz curve is often used to describe the biphasic dose response of PBM. Research reports a biphasic dose response, indicating that lower levels of laser light result in better tissue stimulation and repair than higher levels of laser light[6].

Bone undergoes constant turnover throughout life *via* bone remodeling, which maintains the structural integrity of the skeletal system and contributes metabolically to the body's calcium and phosphorus balance. Remodeling involves resorbing old or damaged bone and depositing new bone material. Two main cell types, osteoclasts and osteoblasts, along with osteocytes, are involved in bone remodeling[7].

An increased number of osteoblasts is necessary to improve bone density. PBM results in a statistically significant increase in osteoblasts as early as 5 d[8].

PBM has been used for retention phases[9], bone regeneration after rapid palatal expansion[10], and to improve implant stability[11].

PBM applied to bone results in increased osteoblasts, newly formed matrix, collagen synthesis, and microvascular reestablishment[12], suggesting positive effects on implant treatment.

It is possible to use PBM during the retention stage, increasing bone density, and decreasing the possibility that the tooth will move because no force is applied.

In this case, it should be applied every week for a month and repeat an application every 3 months. The parameters are the same, the difference is that when no force is applied, no pre-osteoclasts are recruited and the effect of acceleration of movement is not generated.

Considering all the above principles, it can be concluded that PBM cannot be used to achieve absolute anchorage of a tooth[1]; bone remodeling is a dynamic process involving both apposition and resorption. When a laser is applied, it increases osteoblast proliferation without being cytotoxic to preosteoclasts[13]. During orthodontic treatment, we can achieve differential movements by using PBM as an adjuvant before applying force. We can expect greater bone density, which initially resists movement, while PBM is applied to the other teeth to achieve an acceleration effect.

High doses aimed at inhibiting osteoblast proliferation should never be administered during treatment, as this would not inhibit movement, but rather reduce bone density. The claim that high doses of PBM inhibit tooth movement ignores the biology of permanent bone remodeling.

If the treatment plan is well designed and the anchor teeth are identified, PBM should be applied weekly for one month before braces. This protocol should be followed for teeth with inadequate bone support during periodontal therapy before orthodontic treatment to increase bone density and minimize the response to force on the targeted teeth. During treatment, PBM is applied only to the teeth we want to accelerate, not to the teeth we want to move less. Technical abbreviations will be explained the first time they are used. This creates a differential movement and helps reduce the reaction that can occur when relying on teeth or segments with a larger root area to move other teeth.

PROTOCOL

The protocol for preparing a tooth and improving periapical bone density before orthodontic treatment is the same as that used to accelerate tooth movement. The difference between the two scenarios is the stimulus provided by the application of force, which recruits pre-osteoclasts and leads to an increase in osteoclastogenesis[13]. When applied prior to movement (without force), osteoblast proliferation increases, improving the bone density of the anchoring unit. It is not necessary to completely anchor the tooth or group of teeth, as there is always permanent bone remodeling that allows homeostasis.

The proposed protocol involves the use of an 810 nm laser at 0.1W power, delivering between 4 and 6J per tooth for 22 s to the vestibular and lingual root surfaces following the axial axis of the tooth[14]. The energy density depends on the tip selected in the instrument.

CONCLUSION

Normal bone remodeling cannot be avoided by using high doses of PBM. PBM should be applied prior to orthodontic force to reduce tooth movement. PBM can also be used during the application of force to teeth that require acceleration to achieve differential movement in orthodontic treatment. The protocol is the same in both scenarios.

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