Influence of low-intensity laser therapy on the stability of orthodontic mini-implants: a study in rabbits

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Objective. The objective of this study was to assess stability of different orthodontic mini-implants in the tibia of rabbits after low-intensity laser therapy.

Material and methods. Thirty-two mini-implants were assessed, 16 were self-threading (Titanium Fix) and 16 self-perforating (INP). These were inserted into the tibia of rabbits and immediately loaded with a horizontal force of 200*g* uniting 2 mini-implants in each tibia. Then they were submitted to low-intensity laser therapy for 21 days. Sixteen male New Zealand breed rabbits were used, and divided into 2 groups of 8 animals each as follows: Groups INP and TF. In both groups, mini-implants were submitted to low-intensity laser therapy (right tibia) and their respective controls (left tibia) did not undergo laser therapy. After the animals were killed, blocks of bone tissue containing the mini-implants were removed so as to perform mechanical pull-out tests.

Results. There was a statistically significant difference only between Group TF submitted to laser and all the other groups ($P < .05$).

Conclusions. Low-intensity laser was capable of increasing stability of self-threading orthodontic mini-implants. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:e26-e30)

One of the goals in contemporary orthodontics is to find an ideal anchorage system that provides the desired orthodontic movement with maximum control and minimum loss of anchorage,[1,2] thus reducing the dependence on patients' cooperation with regard to the use of intra- and extraoral appliances and elastic mechanics.

Mini-implants are increasingly being used as maximum anchorage for tooth movement in orthodontic treatments.[1,2] Therefore, research has been conducted with the purpose of showing evidence of the applicability, characteristics, shapes, and stability of different types of orthodontic mini-implants.[3]

One of the crucial aspects for the success of stability and maintenance of the appliances in the oral cavity is the quality and preservation of bone in the region that received the implant.[3] Therefore, minimally invasive procedures for implant placement are fundamental for a favorable prognosis.[4]

On the other hand, studies using low-intensity laser for the purpose of alveolar bone repair have shown promising results.[5-9] Cell cultures and in vivo studies in rabbit tibias[5,7] to investigate titanium implants have suggested that laser therapy may induce biostimulation and accelerate integration of dental implants into bone.[5-9]

The use of low-intensity laser therapy in the recovery of soft tissues by the proliferation of repair cells has been shown to be capable of increasing vascularization, as well as having anti-inflammatory and anti-edema effects, depending on the dose of laser applied.

These findings are in alignment with the idea that mechanisms by which laser therapy acts on soft tissue regeneration are similar to those of bone biostimulation. Therefore, the aim of this study was to assess stability of different orthodontic mini-implants in rabbit tibias after low-intensity laser therapy using the pull-out test.

MATERIAL AND METHODS

Experimental groups

Sixteen male New Zealand breed rabbits, aged approximately 4 months and weighing 2500 g, obtained from the vivarium at the Center for Health Sciences, the Federal University of Ceará, were used. The rabbits

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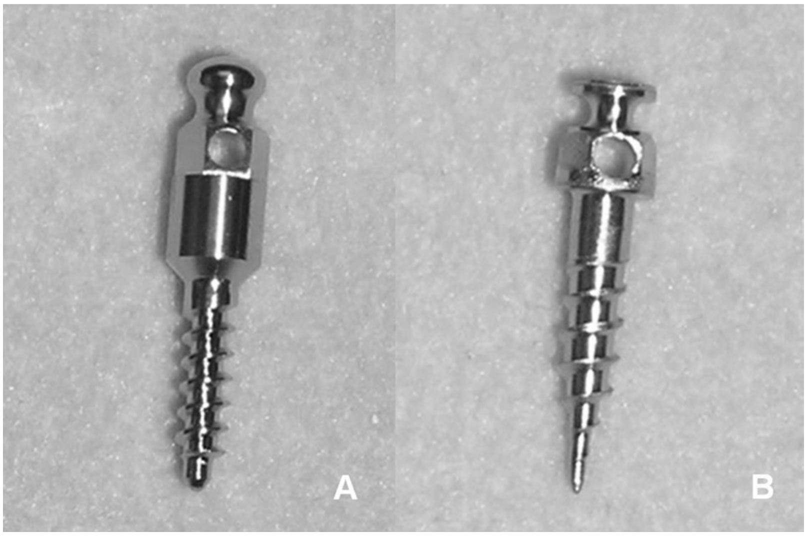

Fig. 1. Mini-implants used in the study: **A,** self-threading mini-implant—titanium Fix; **B,** self-perforating mini-implant—INP.

were randomly divided into 2 groups of 8 animals each (Group INP and Group TF). In both groups, mini-implants were submitted to low-intensity laser therapy (right tibia) and their respective controls (left tibia) did not undergo laser therapy.

A total of 32 INP mini-implants (INP—Sistema de Implantes LTDA., São Paulo, São Paulo, Brazil), all with their specific characteristics, such as self-drilling type, cylindrical screw design, 9-mm length, 6-mm body length, 4-mm screw length, 1.5-mm screw diameter, and Ti-6AI-4V alloy; and 32 TF mini-implants (TF—Titanium Fix, São José dos Campos, São Paulo, Brazil), all with their specific characteristics, such as self-threading type, cylindrical screw design, 9-mm length, 6-mm body length, 4-mm screw length, 1.5-mm screw diameter, and Ti-6AI-4V alloy, were used for study (Figure 1). Before insertion, the mini-implants were characterized and measured with the use of a profile projector (Nikon, Model 6, Tokyo, Japan).

Insertion and pull-out test

The rabbits were anesthetized with an injection of ketamine (Konig S.A., São Paulo, SP, Brazil) and xylazine (Konig S.A., São Paulo, SP, Brazil) administered intramuscularly.[10] After this, trichotomy of the surgical area and local asepsis with 4% chlorhexidine digluconate were performed (School of Pharmacy, Federal University of Rio de Janeiro, UFRJ, Rio de Janeiro, Brazil).

An incision was made in planes in the direction of the long axis of the tibia, at a distance of approximately 4 mm from the implant site. Then, the orifices for implant placement were prepared with a helicoidal drill 1.2 mm in diameter (TF—Titanium Fix, São José dos Campos) mounted in a counter angle, at a speed of 2000 rotations per minute and abundant irrigation with a physiological saline solution. After perforation, the mini-implants were inserted into the tibia with the aid of an insertion key.

Each animal received 4 mini-implants, 2 in each tibia with a distance of 10 mm between them, and these were immediately loaded. Load was applied by means of a nickel-titanium spring (Morelli, Sorocaba, São Paulo, Brazil) with a horizontal force of 200*g*, uniting the 2 mini-implants of each tibia.

To prevent infection after surgery, tetracycline paste (tetracycline hydrochloride paste; School of Pharmacy, Federal University of Rio de Janeiro) was applied to the surgical site.

The surgical loci were sutured with 4.0 suture wire (Ethicon, Johnson and Johnson, São Paulo, Brazil) and then the animals received an injection of sodium dipyrone (0.3 mL/100 g, Novalgina, São Paulo, Brazil). All procedures of this study were performed in accordance with the ethical and legal recommendations established for animal experimentation (Canadian Council on Animals Care, 1981). The animals were kept in individual cages at a temperature ranging from 22 to 26°C under a 12-hour light-dark cycle, under adequate conditions with appropriate rations and water ad libitum.

The bone region perpendicular to the long axis of the mini-implants inserted into the right tibia of each animal received low-power density laser radiation (DMC Equipment, Whitening Laser Model II, São Carlos, São Paulo, Brazil) for 21 days, starting after surgery, with an interval of 48 hours between each laser application, totaling 10 sessions at the end of the experiment. The mini-implants inserted into the left tibia did not receive irradiation (control groups). Irradiation was performed in 2 points: externally and internally to the tibia, at a