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Effect of photobiomodulation with low-level laser therapy in prevention orthodontic pain: Case reports

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***Abstract*—** *In clinical practice and research studies, there is almost a consensus that photobiomodulation therapy with low level laser causes analgesic effect. In this way, the laser can clinically contribute to postoperative pain management after the start of orthodontic treatment. Case Report: the following case reports demonstrate the application of photodynamic therapy in 2 cases immediately after the installation of the orthodontic appliance. The aim of low-level laser treatment would be to reduce possible postoperative pain. The diode laser was employed to irradiate maxillary teeth, immediately after installing an orthodontic appliance for traction. The painful sensitivity decurrent from this procedure was evaluated by a visual scale (Visual Analogue Scale – VAS) 4, 24, 72h and one week after the laser application. The diode laser with light emission at 808 nm wavelength was employed in 12 teeth, 4 points per tooth (2 bucally and 2 lingually, 20 seconds per point), resulting in the total energy was 8 J per tooth. The irradiation protocol were performed by only one operator, per points, employing light beam focused perpendicularly and in contact with the mucosa, which was kept clean and dry, through relative isolation. It appears that there are still few studies which investigated the effects of low level laser for suppressing pain in orthodontics, and the protocols for laser application are still very variable. The evaluated patients showed a low incidence of pain shortly after 24 hours after the installation of the orthodontic appliance. Based on the cases reports, it was observed that laser diode irradiation 808 nm wave- length, energy density 8 J per tooth, was enough to decrease pain, due to installation of the orthodontic appliance. Thus, additional studies are necessary in order to check the best application protocol.*

I. INTRODUCTION

Orthodontic treatment has been increasingly adhered to by adults, mainly motivated by the aesthetic factor, but they are the same ones who most report feeling pain, which is one of the most important reasons why patients are discouraged from seeking orthodontic treatment [1].

Pain is the most cited negative effect of the application of orthodontic force and the greatest concern of patients as well as orthodontists, being reported as a relevant factor for preventing treatment initiation and/or treatment interruption [2,3]. Approximately 90% of orthodontic patients reported pain during treatment, and 39% of these still experienced pains after 7 days [4]. Soon after the installation of the appliance and the first orthodontic arch, the complaint of painful symptoms is frequent [5].

The perception of pain reported by the patient related to the installation of the orthodontic appliance is due to the process of pressure, ischemia, inflammation and edema generated in the periodontal ligament, which starts immediately after the installation of the orthodontic wire in the appliance, but which starts to present hyperalgesia in a few hours [6].

When mechanical force is applied to the teeth, an inflammatory reaction is triggered in the periodontal tissue [7] resulting in the release of inflammatory mediators such as prostaglandins, substance T, histamine and serotonin [5]. Studies have indicated that an increase in prostaglandin-E2 (PGE2) levels is related to the initial intensity of pain, while an increase in interleukin-1 is related to pain occurring 24 hours after the application of orthodontic force [8].

In order to minimize pain-related complaints, orthodontists routinely use pharmacological methods, through the prescription of analgesics [9] or non-steroidal anti-inflammatory drugs, but their effectiveness is still controversial, as there are effects side effects such as allergies and even the inhibition of dental traction [10,11].

In view of the context, an alternative for non-pharmacological pain management has been reported in the literature, which is an aspect of laser therapy, known as photobiomodulation. Some researches report this alternative as a non-invasive, safe and effective therapy [12-17]. The photobiomodulation technique consists in the application of low power laser in certain local points, presenting several benefits in different areas of medicine [18] and also in the treatment of dental diseases [19], being also used in orthodontics due to its effects of improving tissue growth, accelerating bone and nerve regeneration, in addition to reducing pain after installation and orthodontic adjustments currently considered a support measure [20].

Low Power Laser Therapy is a low-intensity, non-thermal light therapy that stimulates photoreceptors in the mitochondrial respiratory chain, leading to increased ATP and reduced oxidative stress. The subsequent cascade of intracellular effects in bone causes a reduction of inflammation and an increase in osteoblastic and osteoclastic activity [21].

Recent articles and case reports have evaluated Low Power Laser Therapy (LTLP) in orthodontic patients and the results have been promising in reducing painful symptoms [15,16,17,22-25].

Thus, this paper aims to describe two clinical case reports with the application of low-power laser aiming to prevent pain after orthodontic appliance installation.

II. CASE REPORTS

Patients J.M., 28 years old, male and M.J.S.L., 32 years old, female attended for bonding of the orthodontic appliance in the upper arch. After the anamnesis, orthodontic documentation and planning, the Morelli Orthodontia Ltda brackets were bonded. Both patients confirmed that they were not using anti-inflammatory or analgesic mediations for various reasons before the orthodontic procedure.

In both cases, after the procedure for bonding the brackets, with the objective of preventing pain related to the installation of the orthodontic appliance, patients received in 12 teeth of the upper arch Low-level Laser Therapy, infra-red with 810 nm wave length and 100 mW power (Laser therapy XT., DMC. Equipamentos São Carlos, Brazil), and it was used 8 J/cm2 as total dose per tooth, divided into four times of 2 J/cm2 per 20 seconds per point. The respective points of application were: P1 - cervical root on the buccal side and P2 - in the root apex, followed by the same procedure P3 - cervical root and P4 - in the root apex on the lingual side. The total application duration was 960 seconds/16 minutes (Fig. 1-3).

Fig. 1. A) P1 - cervical point application root on the buccal side B) P2 root apex application root on the buccal side.

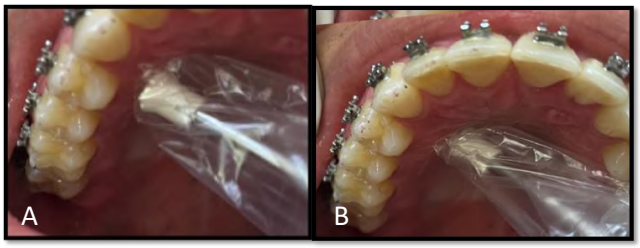

Fig. 2. A) P1 - cervical point application root on the lingual side. B) P2 root apex application root on the lingual side.

A single operator trained in laser therapy performed the laser application with the tip positioned 3mm from the mucosa without touching, at an angle varying from 90 at 70º due to the positioning of the teeth.

Fig. 3. Laser tip positioned 3mm from the mucosa without touching.

Finally, the 0.12' niTi orthodontic wire from the commercial brand Orthometric ltda and the modular elastic from the brand Morelli LTDA were placed.

After the appliance installation procedure and the first orthodontic arch, the patients were instructed to complete a pain intensity experienced questionnaire by a Visual Analogue Scale [26]. Data (VAS) in the following follow-up times after the procedure: 4 hours, 24 hours, 3 and 7 days.

Both patients reported on the VAS scale a little sensitivity (scale index:1) after the placement of the orthodontic appliance within 4 hours and a greater intensity of pain (scale index:2-3), even if expected, within 24 hours after the procedure. However, after this second time of evaluation, on the third day of follow-up, both patients mentioned a sudden drop in the postoperative period, indicating total remission of symptoms after 36 hours (scale index:0). None of the patients report the need to use analgesics or anti-inflammatory.

III. DISCUSSION

Orthodontic movement depends on an adaptation of the alveolar process, which is usually painful due to the inflammatory character of the tissue remodeling process [27]. Thus, the discomfort caused by tooth movement is a frequent concern of patients, even knowing that the perception of pain, in addition to being very individual, varies considerably from individual to individual. Therefore, pain is classified as a highly subjective sensation and therefore very difficult to quantify in scientific research [28].

Therefore, non-pharmacological alternatives have been studied with the aim of at least reducing the postoperative period in the first sessions of orthodontic appliance installation. Low-level laser would be one of those alternatives with a positive factor of not promoting a collateral effect to patients [12,26].

The application of low-level laser has been shown to be effective in a single clinical application for pain reduction in several studies [29-38]. Other clinical researches have already shown a real effectiveness of the laser protocol after two applications to reduce the painful condition [24,34,39]. In a study evaluating successive low-power laser applications in the orthodontic postoperative period, Almallah et al. [34] did not find differences in pain reduction when comparing a single dose with a double application dose. It is observed in the literature that there are no studies reporting the most appropriate number of low-level laser therapy applications; however, we can observe that a single dose after the application of orthodontic force was sufficient to reduce pain in the patients treated.

An important fact to mention is that the intensity of pain described by orthodontic patients varies according to the type of orthodontic force applied. The pain analysis method applied in the clinical sessions presented was the VAS, a scale mentioned in several studies in the literature [29,31,39].

According to studies by Farias et al. [31] and Bicakci et al. [24], patients who received the low-power laser had a significant reduction in pain 24 hours after the application of orthodontic force. According to the literature, discomfort in patients with orthodontic pain starts two hours after orthodontic activation [36] and usually presents a greater intensity after 6–24 hours [17, 30, 23, 31,42,38,37,33]; and likely reduction in the range of two to five days [32,33,17,34,31,37].

When using laser, it is important to choose the most appropriate wavelength for each disease [38]. Laser penetration of the tissues is directly related to wavelength [39,40]. A wavelength of 830nm presents the deepest penetration, able to reach the cortical and alveolar bone tissues; it is more effective than wavelengths between 620 and 670 nm [26, 41].

Regarding the low potency laser application protocol, the choice of dosage is extremely important, and the use of lower doses is indicated, as they make treatments more effective and safe, since doses above 20 J/cm² may have inhibitory action on tooth movement.24 The dose used in the clinical treatments presented was 8 J per irradiated tooth divided into 4 application points of 2 J/cm². This protocol was proposed and applied by Bjordal et al. (2006) [42], since this dosage has the ability to promote anti-inflammatory and analgesic effects [12].

Because of its wavelength, infrared laser has been the treatment of choice for promoting immediate and temporary analgesia, acting on the cell membrane to cause hyperpolarization, that is, a photo-physical change as a result of the light-cell biological interaction [40]. Endorphin synthesis and the action potential of neural cells increase, whereas the amount of bradykinin aswell as the activity of the C-fibres driving the pain stimuli decreases [43], resulting in relief of painful symptoms [26, 44].

In view of the findings in the literature that provide evidence that it would not be necessary to irradiate the entire area of the teeth involved in order to achieve the desired analgesic effect, we chose a point at the apex and another point at the middle third of the root, both on the buccal side and on the palatal side. This is because the pressure receptors are most often in the apical two-thirds of the root [12,26].

As many orthodontists are concerned, the present case reports set out to analyze the postoperative period at an initial moment of orthodontic treatment right after the installation of the orthodontic appliance and first arch. This clinical observation was also investigated by Thurhani et al. (2006) [15], where a single laser dose was applied for 30 s, as well as in the studies by Tortamano et al. (2009) [17], where it is observed application of a dose equivalent to 2.5 J/cm² distributed in five irradiated areas. Both studies conclude that LTBP is effective in controlling pain after the installation of the first arch, which corroborates the observations in this clinical follow-up article. The protocol employed by Tortamano et al. (2009) [17] indicated that a laser therapy application time between 32 and 37.5 minutes per patient is necessary, whereas In the present study, the total application time was 16 minutes due to the number of teeth involved in the application protocol.

In agreement with the findings of Marini et al. [29] we observe how opportune the possibility of using the low-level laser therapy protocol in daily orthodontics practice.

IV. CONCLUSION

More studies to develop complete protocols in order to facilitate the application and execution in clinical practice of laser are really necessary to convert safe laser irradiation with effective dosage into a routine treatment for orthodontic pain.

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