Original Article

Pain Reduction Using Low Level Laser Irradiation in Single-Visit Endodontic Treatment

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Abstract:

Introduction: Post-endodontic treatment pain is a relatively common condition which needs analgesics for patient's pain relief. Low-level laser therapy (LLLT) is suggested as a non-pharmacological and non-invasive treatment for dealing with painful conditions. The purpose of this study was to evaluate the pain relief effect of LLLT after endodontic treatment.

Methods: Eighty patients randomly received either LLLT (n=40), or placebo laser (n=40) after the completion of endodontic treatment for their first permanent upper or lower molars. In the laser group, the patients received a single course of low level laser therapy (Whitening Lase II- Laser DMC, Samsung, Korea) for 80 second (a dose = 70 j/cm²) per tooth. Intensity of post treatment pain was recorded using a questionnaire (The McGill Pain Questionnaire) and a numeric rating scale (Visual Analogue Scale {VAS}) at 4, 8, 12, 24, and 48 hours. VAS is a 10 cm line with "no pain" at one end, and "worst pain imaginable" at the other end. This method makes it possible to quantify pain levels. T-test and Chi-square test were used for data statistical analyses.

Results: Compared to the placebo group, post-endodontic pain was significantly reduced in LLLT group at 4, 8, 12, and 48 hours ($P<0.05$). But the difference between the two groups was not significant at 24 hours after endodontic treatment ($P>0.05$).

Conclusion: Regarding the significant pain reduction in LLLT group at 4, 8, 12, and 48 hours after endodontic treatment, LLLT seems to be an effective and non-pharmacological approach for the reduction of post-endodontic treatment pain.

Keywords: laser therapy; laser irradiation, low power; pain relief.

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Introduction

The recently rapid developments in laser technology and better understanding of bio-interactions of different laser systems have broaden new horizons for clinical use of laser in contemporary endodontics. Diagnosis of pulp situation, pulpotomy, pulp capping, disinfecting of the root canal system, obturation, non-surgical endodontic treatment, and periapical surgery are instances of laser application in endodontic procedures. Unfortunately, lack of adequate well-

designed researches has made this approach less routine than conventional techniques (1). Laser is a monochromatic, collimated, coherent, and intense beam of light produced by stimulated emission of radiation of a light source. This light source consists of a glass, or ceramic tube containing an active medium (in gas, liquid, or solid form) which identifies and distinguishes the type of emitted laser beam. Visible beams (i. e. the Argon laser at 488 or 518 nm) and invisible beams in the infrared range (i. e. CO_2, Er: YAG (Erbium Substituted: Yttrium Aluminium Garnet), Er-Cr: YSGG (Erbium, Chromium Doped Yttrium Scandium Gallium Garnet), Nd: YAG (Neodymium-Doped Yttrium Aluminium Garnet)) are used in dentistry (2). The properties of a specific laser beam particularly wavelength and the optical characteristics of the particular target tissue determine the type and the extent of interaction which may occur (3). A knowledgeable understanding of characteristics of each laser system is crucial in choosing a suitable system and wavelength. For example, the CO_2 laser is well absorbed by biological tissues with high water content including all soft and hard tissues. However, because of its high thermal absorption during enamel and dentin cutting it may cause pulpal damage (3, 4). Low-level laser therapy (LLLT) is well established in clinical dentistry because of its anti-inflammatory, regenerative, and teeth etching effects (5-9). Recently, low-level laser therapy (LLLT) is considered as an adjunct to alleviate post-dental procedure pains (10, 11). Furthermore, LLLT has also shown non-thermal and bio-stimulatory effects and the energy output of the device is low enough not to exceed an irradiated tissue temperature of 36.5°C (12). Activation of microcirculation, along with cellular metabolism has been observed following LLLT (13-15). Although the mechanism of pain relief subsequent to LLLT still needs to be studied, pain mediation and stimulation of endorphin production were proposed (16). Moreover, some researchers attribute the analgesia to anti-inflammatory and neural effects of LLLT (12), including stimulation of nerve cell and lymphocyte respiration, stabilization of membrane potentials, and the release of neurotransmitters in the inflammatory tissue (17-19). In addition, elongation of substance P and CGRP-rich (Calcitonin Gene-Related Peptide) neuritis was found to be reduced in vitro (20). The purpose of this study was to evaluate the pain reduction effect of LLLT after endodontic treatment of first permanent molars.

Methods

Eighty patients (51 females, 29 males, mean age: 29.85±8.64 years) with the demand for endodontic treatment on their first permanent molars were included in the trial, and informed consent was obtained prior to the treatments. Patients had no history of medical complications, or systemic diseases (such as diabetes, malignancy, cardiovascular problems, neurological and psychiatric disorders). In addition, they had to stop using any antibiotics or analgesics during a week before the endodontic treatment. All patients were randomly selected and divided into two groups. In the laser group (n=40, mean age: 31.78±9.18), patients were treated with LLLT (Whitening Lase II- Laser DMC, Samsung, Korea). In the control group (n=40, mean age=27.92±8.11), patients received placebo without laser. The patients were blinded to the difference between these groups. All root canal therapies were performed in a single-visit treatment. After the standard chemomechanical preparation of the canals (Master Apical File: size #25 to #40 k-files depending on anatomical features of the roots), they were obturated using lateral compaction technique and AH26 sealer (DENTSPLY Caulk). Occlusal contacts with opposing teeth were eliminated for all treated teeth. No procedural error (i.e. perforation, transportation, missed canal) was accepted for teeth entering the survey. Subsequently, LLLT (Whitening Lase II- Laser DMC, Samsung, Korea) was given to endodontically treated molars by virtue of a dental applicator positioned at a right angle to the mucosa at the level of the apices. Application of the laser probe was to both the buccal and lingual mucosae overlying the apices of the target tooth. Total exposure time for each tooth was 80 seconds (a dose = 70 j/cm² for analgesia). The laser unit used in this study was a diode laser (Whitening Lase II- Laser DMC, Samsung, Korea) with a wavelength of 808 nm. The laser beam emitted a constant wave with a mean output of 100 mw. All patients were instructed by one operator to complete a survey

at home. Pain was evaluated using the McGill Pain Questionnaire (MPQ), and patients were instructed to fill in the questionnaire at 4, 8, 12, 24, and 48 hours after root canal treatment. Any of the patients taking analgesics after the treatment, were excluded from the survey. The information collected from the questionnaires was about the prevalence and the intensity of post-treatment pain. The intensity of pain was evaluated on a numeric rating scale (Visual Analogue Scale) of 0 for "no pain" to 10 for "unbearable pain". This method makes it possible to quantify the pain level. After the questionnaires were collected, the data were statistically analyzed with T test and chi square test, and the level of significance was determined at 0.05.

Results

There was no significant difference in gender distribution between two groups (p>0.05). (Table 1)

Pain was the most prominent chief complaint in both the laser group (72.5%) and the placebo group (77.5%). There was no significant difference between the two groups (p>0.05). (Table 2)

There was no significant difference between mean ages of patients between two groups (p>0.05). (Table 3)

In the laser group, post-treatment pain was significantly lower than in the placebo group at 4, 8, 12, and 48 hours after non surgical endodontic treatment. (Table 4)

Table 1. Gender distribution of patients

	Female	Male
Laser group	25 (62.5%)	15 (37.5%)
Placebo group	26 (65%)	14 (35%)
Total	51 (63.8%)	29 (36.2%)

Table 2. Prevalence of pre-treatment pain

	Negative	Positive
Laser group	5 (12.5%)	35 (87.5%)
Placebo group	4 (10%)	36 (90%)
Total	9 (11.2%)	71 (88.8%)

Table 3. Mean age of patients

	Mean	SD
Laser group	31.78	9.18
Placebo group	27.92	8.11

Table 4. Prevalence of post treatment pain was significantly reduced after laser therapy at 4h, 8h, 12h, and 48h. Neither patients' gender, nor patients' age had any effect on the outcome of LLLT in the two groups (P>0.05).

Pain	Mean	P-value
Pre-treatment		
Laser	2.85	0.058
Placebo	3.20	
Post-treatment		
4h		
Laser	1.8	0.0001
Placebo	2.55	
8h		
Laser	1.27	0.0001
Placebo	1.80	
12h		
Laser	1.00	0.032
Placebo	1.15	
24h		
Laser	1.00	0.323
Placebo	1.02	
48h		
Laser	1.00	0.006
Placebo	1.18	

Discussion

Some patients may experience moderate to severe pain after endodontic treatment, very few experience what is commonly referred to as a flare-up requiring an unscheduled visit with unplanned treatment intervention to manage the symptoms (21). A recent systematic review of clinical trials showed that there was no difference in the final outcome of the endodontic treatment between single- or multiple-visits; however those patients treated in one-visit were more likely to take analgesic drugs (22). In this study, the protocol for endodontic treatment was the single-visit protocol. Post-treatment pain was shown to be significantly reduced following laser therapy at 4, 8, 12, and 48 hours after single-visit endodontic treatment. The transmission of laser through tissue is highly wavelength specific, and is optimal in the optical range of 500 to 1200 nm[12]. The wavelength of laser unit was 880 nm which conformed to optimal optical range. Perception of pain varies widely from person to person which may cause bias. Thus, we used both a questionnaire and a numeric rating scale. There is no other study about application of LLLT for relief of pain after non-surgical endodontic treatments. Lizarelli reported significant reduction of pain following irradiation

of low level laser pre- and post-implant surgeries (23). Sakuraba, et al. showed LLLT diminished pain in sensitive pulps using a semiconductor low level laser unit (24). Kreisler demonstrated more pain reduction in laser group than placebo group in first day after endodontic surgery (25). In one study, application of low level red and infrared laser was significantly effective in the treatment of dentin hypersensitivity (26). Enwemeka, et al. in their meta-analysis represented low level laser was significantly effective in pain control and tissue repair (27). They concluded that insignificant results of some studies were due to small sample size. In this study, number of patients was enough which did not pose such a problem. Boj, et al. reported less pain perception in pediatric patients in laser treatment (28). In addition, other researchers showed the same results for LLLT in orthodontic treatment procedures. Results of all studies mentioned above are consistent with the result of our study. In contrast, Payer et al. reported that LLLT gave no clinical advantage to endodontic surgery (29). The difference between results of this study and Payers' may be due to using different methodologies and study designs.

Conclusion

In this study, low level laser therapy was an effective approach for the reduction of post-endodontic treatment pain at 4, 8, 12, and 48 hours after first permanent molar root canal treatment. There was no difference in painful symptoms in maxillary or mandibular molars ($P > 0.05$). As well as perception of pain regarding the gender of the patients ($P > 0.05$).Further researches seem to be helpful for considering LLLT as an alternative to analgesics or anti-inflammatory drugs to deal with post-endodontic treatment pain.

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