Effect of Preoperative Ibuprofen in Controlling Postendodontic Pain with and without Low-Level Laser Therapy in Single Visit Endodontics: A Randomized Clinical Study

Abstract
Aim: The aim of this study is to evaluate the effect of low-level laser irradiation and ibuprofen in reducing the onset and severity of postoperative pain following single visit endodontics.

Materials and Methods: One hundred and twenty patients were recruited for this study. Group A (n = 30) patients were administered 400 mg of ibuprofen orally 1 h before the institution of an endodontic procedure. Group B (n = 30) patients were given irradiation of a low-level laser at 50 Hz for 3 min after the standard endodontic procedure at the periapical region on both buccal and lingual aspect. Group C (n = 30) patients were given preoperative ibuprofen followed with a low-level laser at 50 Hz for 3 min after endodontic treatment. Group D (n = 30) patients were administered no preoperative ibuprofen nor low-level laser irradiation after the endodontic procedure. The patient immediately recorded his/her pain perception on the Heft Parker pain survey after completion of the appointment and at 4, 8, 12, 24, and 48 h postoperatively. Inter group analysis was carried out using the analysis of variances with “least significant difference” post hoc test. For intra group analysis, Student’s t-test was used. Chi-square test was applied for nonparametric data. Results: Pain was significantly reduced in all the treatment groups postoperatively. Ibuprofen showed significant pain reduction at 4 h and 8 h period. The combination of low-level laser and ibuprofen showed the best results in terms of postoperative pain reduction. Conclusion: This study proved that low-level laser therapy can be an effective alternative for conventional use of nonsteroidal anti-inflammatory drugs in controlling postendodontic pain thereby eliminating the adverse effects of such drugs on the patients.

Keywords: Heft Parker pain scale, ibuprofen, low-level laser therapy, single visit endodontics

Introduction
Single-visit root canal offers several advantages, including a reduced flare-up rate, decreased number of operative procedures, and no risk of inter-appointment leakage through temporary restoration.[1] The major concern regarding single appointment endodontics has been a postoperative pain. Recently, Mulhern et al.,[2] and DiRenzo et al.,[3] in their studies and in a study conducted by Wang et al.,[4] on 100 vital teeth, found no statically significant difference between pain levels of single and multiple visit groups. Certain factors influence the progression of postoperative pain,[5,6] which includes the history of preoperative pain and the need for re-treatment. Microorganisms are usually regarded as the most common cause of postoperative pain, other causes include mechanical or chemical injury to pulpal or peri-radicular tissues.[7] Many clinical studies have reported varying degrees of postendodontic pain, ranging from 25% to 40%.[8,9] Postoperative endodontic pain is linked to inflammatory mediators prostaglandins, leukotrienes, bradykinin, and serotonin that activate sensitive nociceptors, leading to both peripheral and central mechanisms of hyperalgesia. Prostaglandins play a critical role in the pathogenesis of pulpal and periradicular disease.[10] Nonsteroidal anti-inflammatory drugs (NSAIDs) are the most commonly prescribed analgesics for preventing postoperative pain.[11] The most commonly investigated is ibuprofen it is safe, widely prescribed, inexpensive and has effective analgesic and anti-inflammatory action for postoperative pain.[12]

Rapid developments in laser technology and a better understanding of bio interactions

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of different laser systems have broadened the clinical use of laser in contemporary endodontics. A low-level laser also called a soft or a cold laser has no thermal effect on tissues and produce a reaction in cells through light, called photobiosimulation or photochemical reaction. These lasers have an average output power range between 5 and 500 mW. Low-level laser therapy (LLLT) is well established in clinical dentistry because of its anti-inflammatory, regenerative, and teeth etching effects.\(^{[13,14]}\) LLLT has also shown nonthermal, and bio-stimulatory effects as the energy output of the device are low enough not to exceed an irradiated tissue temperature of 36.5°C.\(^{[15]}\) LLLT is considered as an adjunct to alleviate postdental procedure pains\(^{[16,17]}\) and no study has compared the effect of preoperative ibuprofen with the combination of LLLT in reducing postendodontic pain.

Therefore this study randomized out to evaluate the effect of preoperative analgesics and LLLT for postendodontic pain reduction.

**Materials and Methods**

**Subjects and patients**

The study involved one hundred and twenty patients who required conventional root canal therapy.

The patients were selected according to the following criteria.\(^{[18]}\)

**Inclusion criteria**

Permanent teeth with fully formed apex, teeth with vital pulp, teeth with no periapical radiolucency, patients having preoperative pain.

**Exclusion criteria**

Teeth with incompletely formed apex, teeth requiring secondary endodontic treatment, patients having complicating systemic disease such as diabetes, malignancy, pregnancy, central nervous system disorders, Cardiovascular system (CVS) disorders, respiratory disorders, asthma patients, psychiatric disorders, immunocompromised patients, patients taking anti-inflammatory or antibiotics, patients giving history of analgesic or antibiotic intake 1 week before treatment, patients below 18 years of age, patients above 65 years of age, patients having history of peptic ulcer or gastrointestinal bleeding, teeth having calcified canals, teeth having multiple canals or multirooted teeth, teeth affected with periodontal disease. Teeth tender on percussion, teeth having procedural errors such as transportation, perforation, missed canals.

A thorough history was recorded from the patients. Informed consent was obtained, and a clinical examination was administered. The examination included cold pulp testing, heat testing, electric testing, percussion and palpation evaluation, periodontal probing, mobility assessment, and a periapical radiograph. All past and present symptoms of the involved tooth were recorded.

A pulpal diagnosis was determined from the data collected in the examination and was recorded. Only those patients with a diagnosis of symptomatic irreversible pulpitis were included in the study. Patients were randomly assigned into four treatment groups. Group A (n = 30) patients were administered 400 mg of ibuprofen orally 1 h before the institution of an endodontic procedure. Group B (n = 30) patients were given irradiation of a low-level laser at 50 Hz for 3 min after the standard endodontic procedure at the periapical region on both buccal and lingual aspect. Group C (n = 30) patients were given preoperative ibuprofen followed with a low-level laser at 50 Hz for 3 min after endodontic treatment. Group D (n = 30) patients were administered neither preoperative ibuprofen nor low-level laser irradiation after endodontic procedure.

**Endodontic procedure**

Before treatment, the patient filled out his/her initial perception of pain on the pain survey. For ibuprofen group patients took 400 mg ibuprofen (Brufen, Abbot, India Ltd.,) orally 1 h before the procedure. Local anesthetic (1:80,000 Arcaine, Aarge Pvt Ltd., India) was administered, and endodontic access was achieved under rubber dam isolation.

Cleaning and shaping of the canal systems were achieved in the following manner; early negotiation and cleaning and shaping was completed with Flex-O-Files (Maillefer Switzerland) #8, #10, #15, #20. An initial working length reading was taken with the apex locator root ZX mini (J Morita Japan) and a confirmatory radiograph was taken. The working length was estimated to be 0.5 mm short of the radiographic apex.

Canals were prepared using engine driven rotary nickel titanium pro taper files (Dentsply Maillefer, Ballaigues Switzerland) following manufacturer’s instructions. RC prep (Premier Dental Products Co., Philadelphia, PA, USA) was used as a lubricant. Irrigation was performed with 5.25% sodium hypochlorite after each file change. Apical enlargement was accomplished with using finishing files which ranged from F1 to F5 depending upon the initial diameter of the canal. Canals were filled with protaper universal Gutta percha (Dentsply Maillefer) and AH plus sealer (Dentsply De Trey, Gmbh, Konstanz, Germany) using a lateral compaction technique and restored with composite (Ceram X Duo Dentsply India Ltd.). All cases were completed in one appointment (access, cleaning/ shaping, and obturation). For patients in laser groups, low-level laser irradiation (Quanta Pulse Pro Jsc “Milta-Humanitarian-Information Technologies Design and Production Company” Moscow, Russia) was given at the periapical area [Figure 1]. Laser tip was placed in contact mode perpendicular to the periapical region of the teeth both buccally as well as lingually for 3 min [Figure 2].

Patients were then given the Heft and Parker\(^{[19]}\) pain rating scale and were instructed to mark the individual pain level at 4, 8, 12, 24, and 48 h after root canal therapy. Patients
then recorded postoperative pain using the pain rating scale and returned 48 hours after treatment.

Statistical analysis
Parametric data were analyzed with the help of means and standard deviations. Inter group analysis was carried out using the analysis of variances with “least significant difference” post hoc test. For intra group analysis, Student’s t-test was used. Chi-square test was applied for nonparametric data. The value of $P < 0.05$ was considered statistically significant.

Results
Fifty-two female patients and 68 male patients participated in the study [Table 1]. The gender distribution was not significant among the groups ($P = 0.965$). The age of the patients ranged from 18 to 64 years [Table 2]. There was no statistically significant age difference between the four groups ($P = 0.973$). All groups showed significantly less postendodontic pain levels as compared to preoperative pain levels.

Result at 4 h [Table 3] a significant difference was observed between Group A and Group D, Group B and Group C, Group B and Group D, and Group C and Group D. The ibuprofen laser combination showed the least mean pain score of 3.6 and was the most effective in controlling pain at this time interval. This was followed by the ibuprofen

**Table 1: Sex distribution among treatment groups**

| Group   | Sex | $P$  |
|---------|-----|------|
|         | Male (%) | Female (%) |  |
| Group A | 17 (56.7) | 13 (43.3) | 0.965 (NSSD) |
| Group B | 16 (53.3) | 14 (46.7) | |
| Group C | 17 (56.7) | 13 (43.3) | |
| Group D | 18 (60)  | 12 (40)   | |

NSSD=No statistically significant difference

**Table 2: Age distribution among treatment groups**

| Group   | $n$ | Mean (years) | SD | Range | $P$    | Significance |
|---------|-----|--------------|----|-------|--------|--------------|
| Group A | 30  | 34.4         | 11.54 | 18-60 | 0.973  | NSSD         |
| Group B | 30  | 35.4         | 11.50 | 22-63 |        |              |
| Group C | 30  | 35.0         | 8.90  | 22-62 |        |              |
| Group D | 30  | 35.8         | 14.47 | 18-64 |        |              |

SD=Standard deviation, NSSD=No statistically significant difference

**Table 3: Mean pain scores at various time intervals after treatment**

| Groups       | Preoperative pain scores | Pain score at 4 h | Pain score at 8 h | Pain score at 12 h | Pain score at 24 h | Pain score at 48 h |
|--------------|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Group A      | 87.3                     | 7.5               | 6-8               | 17.6              | 14.3              | 7.1               |
| Group B      | 85.8                     | 14.2              | 13.4              | 7.4               | 5.4               | 1.5               |
| Group C      | 88.9                     | 3.6               | 3.5               | 3.1               | 2.3               | 0.8               |
| Group D      | 89.6                     | 25.7              | 24                | 22.7              | 18.6              | 11.3              |
Combination proving to be most effective in controlling pain.

Result at 12 h. A significant difference was observed between Group A and Group B, Group A and Group C, Group B and Group D, Group C and Group D. The lowest pain score was given by laser ibuprofen group with a mean pain score of 3.1. It was followed by laser group at 7.4. Ibuprofen showed no significant pain relief as compared to control.

Result at 24 h. A significant difference was observed between Group A and Group B, Group A and Group C, Group D and Group B, Group C and Group D. The laser ibuprofen combination was most effective followed by the laser group.

Result at 48 h. The results were similar to that observed at the 24 h interval. The laser ibuprofen combination was most effective followed by the laser group. Table 4 shows the inter group comparison.

Discussion

Results from the present study indicate that pain was significantly reduced in all the treatment groups postoperatively [Figure 3]. Ibuprofen showed significant pain reduction at 4 h and 8 h period as compared to control group. A prophylactic dose of 400 mg was used in this study. These results are consistent with that found by Dionne et al.,[20,21] and Winter et al.[22] More recently, Arslan et al.,[23] also found that ibuprofen was more effective in reducing postendodontic pain at 6 h period. Prophylactic administration of ibuprofen before RCT can block the Cox pathway and by this application, pain sensation can be blocked.

Laser group showed significant pain reduction at 12, 24, and 48 h posttreatment as compared to ibuprofen group. While it was nonsignificant at 4 and 8 h when compared to ibuprofen group. Furthermore, pain was significantly reduced at all-time intervals when compared to control. A significant difference was also found at 4 and 8 h when compared to laser ibuprofen combination with the combination showing increased pain control.

Only one study has previously evaluated the effect of low-level laser irradiation on postendodontic pain. Asnaashari et al.,[24] found that low-level laser significantly reduced postendodontic pain at 4, 8, 12, and 48 h. Lizzarelli,[25] reported a significant reduction of pain following irradiation of low-level laser pre- and post-implant surgeries. Sakuraba et al.,[26] showed LLLT diminished pain in sensitive pulps using a semiconductor low-level laser unit. Kreisler et al.,[27] demonstrated more pain reduction in laser group than the placebo group in the 1st day after endodontic surgery. In one study, application of low-level red and infrared laser was significantly effective in the treatment of dentin hypersensitivity.[28] Enwemeka et al.,[29] in their meta-analysis represented low-level laser was significantly effective in pain control and tissue repair. They concluded that insignificant results of some studies were due to small sample size.

In this study, a number of patients was enough which did not pose such a problem. Boj et al.,[30] reported less pain perception in pediatric patients in laser treatment. In addition, other researchers showed the same results for LLLT in orthodontic treatment procedures.

The combination of low-level laser and ibuprofen showed the best results in terms of postoperative pain reduction. The difference was significant at all-time intervals as compared to control while it was significantly better at 12, 24, and 48 h’s period as compared to ibuprofen.

When compared to laser alone the difference was significant at 4 and 8 h. The low-power lasers showed a significant analgesic effect in the present study. The wavelength of laser unit was 905 nm for laser irradiation (power 12–16 mw, 875 nm for broadband infra-red irradiation (power 60 mw) and 640 nm for visible red irradiation (power 7 mw) which conformed to the optimal optical range.

Currently the following analgesic effects are recognized, low-level laser inhibit the release of mediators from injured tissues, decrease concentration of chemical agents such as histamine, acetylcholine, serotonin, H+ and K+, all of which are pain mediators, inhibit concentration of acetylcholine, a pain mediator, through increased acetylcholine esterase activity, cause vasodilatation and increase blood flow to tissues, accelerating excretion of secreted factors, better circulation leads to a decrease in tissue swelling, decrease tissue edema by increasing lymph drainage, remove the pressure on nerve endings, resulting in stimulation decrease, decrease sensitivity of pain receptors as well as transmission

| Table 4: Inter group comparison of pain scores among treatment groups at various time intervals |
|---|---|---|---|---|---|---|---|
| Inter group comparison | At 4 h | At 8 h | At 12 h | At 24 h | At 48 h |
| | P | Significance | P | Significance | P | Significance | P | Significance |
| Group A versus Group B | 0.241 | NS | 0.195 | NS | 0.036 | S | 0.040 | S | 0.046 | S |
| Group A versus Group C | 0.490 | NS | 0.508 | NS | 0.003 | S | 0.009 | S | 0.044 | S |
| Group A versus Group D | 0.002 | S | 0.001 | S | 0.285 | NS | 0.340 | NS | 0.184 | NS |
| Group B versus Group C | 0.041 | S | 0.039 | S | 0.363 | NS | 0.495 | NS | 0.808 | NS |
| Group B versus Group D | 0.035 | S | 0.036 | S | 0.002 | S | 0.004 | S | 0.002 | S |
| Group C versus Group D | 0.001 | S | 0.001 | S | 0.001 | S | 0.001 | S | 0.001 | S |

NS=Non-significant difference, S=Significant difference
of impulses, decrease cell membrane permeability for Na+ and K+ and cause neuronal hyperpolarization, resulting in increased pain threshold, the production of β-endorphin, injured tissue metabolism is increased by electromagnetic energy of laser. This is induced by ATP production and cell membrane repolarization.\[31\]

**Conclusion**

This study suggests that LLLT can be an effective alternative for conventional use of NSAIDs in controlling postendodontic pain thereby eliminating the adverse effects of such drugs on the patients. Further research is needed for assessing the required intensity and time intervals of the laser irradiation in treating postendodontic pain.

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**Conflicts of interest**

There are no conflicts of interest.

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