



The Efficacy of Low-level Laser Therapy on Pain caused by Placement of the First Orthodontic Archwire: A Clinical Study

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ABSTRACT

Aim: This study was conducted to clinically evaluate the effect of low-level laser therapy (LLLT) as a method of reducing pain reported by patients after placement of their first orthodontic archwires.

Materials and methods: A sample of 10 patients with an age group of 12 to 26 years with moderate-to-severe anterior crowding was selected. Each patient was assigned to an experimental group (left quadrant with laser therapy) and a control group (right quadrant with no laser therapy). Low-level laser therapy was given immediately after the placement of initial archwire. All patients were instructed to fill up a survey form at home over the next 7 days.

Results: The results revealed that the average onset of pain in the experimental group (16.10 hours) was significantly reduced when compared with the control group (3.10 hours). The most painful day was similar for both the groups. The pain ceased much sooner in the experimental group than in the control group. The intensity of pain was lesser in the experimental group when compared with the control group.

Conclusion: Low-level laser therapy was an effective and noninvasive method for controlling pain in orthodontic patients after receiving their first archwires. The duration and intensity of pain reduced with the application of LLLT.

Clinical significance: Pain reduction during orthodontic procedures.

Keywords: Low-level laser therapy, Nickel–titanium wires, Orthodontic pain.

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INTRODUCTION

Force applied to a tooth by orthodontic appliances results in ischemia, inflammation, and edema immediately after the compression of the periodontal ligament. Algogens, such as histamine, bradykinin, prostaglandins, serotonin, and substance P are released after periodontal ligament compression and activation of the inflammatory reaction.¹

Pain during orthodontic treatment usually appears 2 hours after the application of orthodontic force, reaches a peak level at 24 hours, and lasts approximately 7 days.^{1,2} Pain is of multifactorial nature and depends on variables, such as patient's subjective previous pain experiences, age, type of appliance, present emotional state and stress, cultural differences, and sex.^{1,2} Discomfort and pain after initial separator or archwire placement are common experiences among orthodontic patients.^{1,3}

Research showed that nonsteroidal anti-inflammatory drugs (NSAIDs) are the preferred over-the-counter medications for orthodontic pain.^{1,4} However, high doses of NSAIDs have been reported to disrupt tooth movement. Some studies reported similar levels of pain relief with NSAIDs and acetaminophen.

Other nontraditional methods of pain relief include LLLT, transcutaneous electrical nerve stimulation, vibratory stimulation, and analgesic gum.¹ The Low-level laser has been proven to produce analgesic, anti-inflammatory effects, and accelerated tissue repair in various therapeutic and clinical applications.⁵ It was found that LLLT can

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accelerate bone regeneration and stimulate the synthesis of collagen. Increased osteoblastic and osteoclastic activity after LLLT was observed *in vivo* and *in vitro*.⁶

The transmission of laser through tissue is highly wavelength specific and is most optimal in the optical window of 500 to 1200 nm.⁵ The 830 nm wavelength of the gallium-arsenide-aluminum (Ga-As-Al) diode laser lies in this optical window, and it has been shown to have the greatest tissue penetration when compared with the other laser systems (Fig. 1).⁷

The purpose of this study is to evaluate the effect of LLLT on pain caused by the placement of the first orthodontic archwires based on patient reports.

MATERIALS AND METHODS

A sample of 10 patients with an age group of 12 to 26 years with moderate-to-severe anterior crowding had their 0.022 slot MBT appliance placed. The left quadrants of the patients were set as experimental side and received

the laser therapy. The right quadrants of the same patients were set as control side and no laser therapy was given. The patients received a 0.016 superelastic nickel–titanium (NiTi) wires as their first archwire.

Low-level laser therapy started immediately after the placement of the first archwire. The site of laser application was air dried. Both the buccal and lingual mucosae covering the dental root were exposed to the laser beam. Irradiation was done in the following five areas of the oral mucosa (Figs 2 and 3):

1. Distal aspect of apical third
2. Mesial aspect of apical third
3. Center of middle third
4. Distal aspect of cervical third
5. Mesial aspect of cervical third

Each area was exposed to LLLT for 16 seconds or 0.5 J per cm². Each tooth received a dose of 2.5 J per cm² on each side (buccal and lingual) for analgesia and bone stimulation. The mean time to complete the laser application in each quadrant was 18.5 minutes for nonextraction



Fig. 1: Low-level laser therapy unit

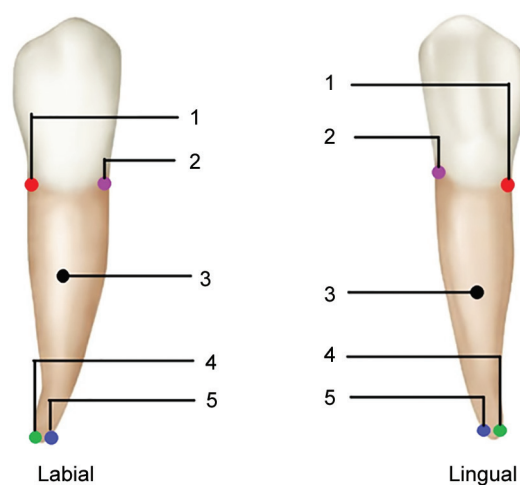


Fig. 2: Diagrammatic representation of the anatomical points of laser application



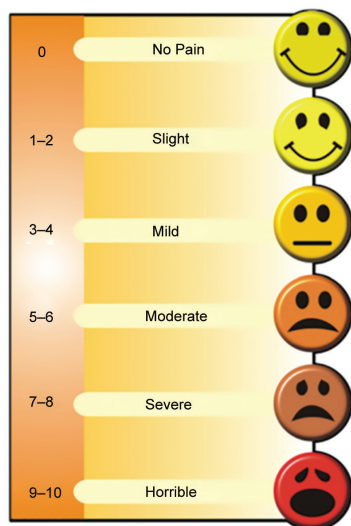
Figs 3A and B: Low-level laser therapy on the buccal and lingual aspect of the experimental side

Table 1: Patient report

Name:		Age:		Sex:							
1. When did you receive the appliance?											
2. How many hours after receiving the appliance did you have pain?											
3. When did you have most serious pain while undergoing the therapy?											
	1	2	3	4	5	6	7				
Day											
4. When did your pain disappear?											
	1	2	3	4	5	6	7				
Day											
5. Mark with an "X" on the scale corresponding to the pain you have experienced (from 1 to 10) during the next 7 days based on the visual analog pain scale.											
Example:											
	0	1	2	3	4	5	6	7	8	9	10
1st day									X		

	0	1	2	3	4	5	6	7	8	9	10
1st day											
2nd day											
3rd day											
4th day											
5th day											
6th day											
7th day											

6. Visual analog pain scale.



cases and 16 minutes for patients who had their premolars extracted.

All patients were instructed to fill up a survey form at home over the next 7 days and were told not to take any antianalgesics. The survey contained a questionnaire which quantified the pain levels the patients experienced (Table 1). The reports were collected from the patients on the 8th day.

Statistical Analysis

Descriptive and comparative statistical analysis has been carried out in the present study. The statistical software,

namely, R and Statistical Package for the Social Sciences version 13 was used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs, tables, and so on.

The mean and standard deviation (SD) for each variable were calculated using the above-mentioned software system. The null hypothesis was tested using Mann-Whitney test. The significance level was set at $p < 0.05$.

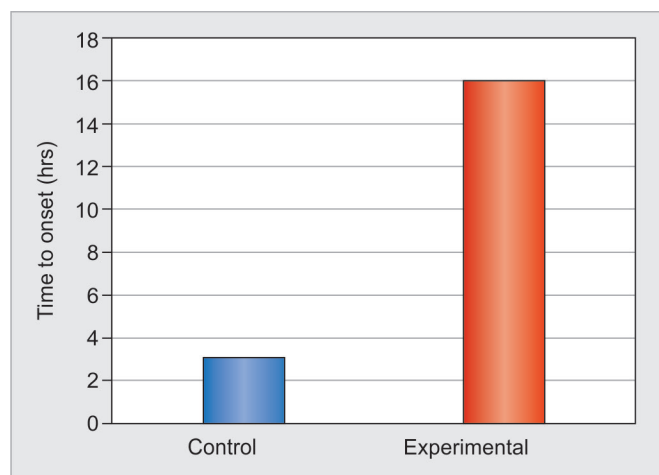
RESULTS

The results revealed a significant difference between the two groups. The average onset of pain in the experimental

Table 2: Comparison of onset of pain between the two groups

Group	Mean	SD	SEM	Mean diff	Z	p-value
Control	3.10	1.52	0.48	-13.000	-3.794	<0.001*
Experimental	16.10	5.49	1.73			

SEM: Standard error of the mean; SD: Standard deviation; *p<0.001 very significant

**Graph 1:** Comparison of onset of pain between the two groups

group (16.10 hours) was significantly reduced when compared with the control group (3.10 hours). The significance level of $p < 0.001$ showed statistically significant difference between the two groups (Table 2 and Graph 1).

The most painful day was similar for both the groups. For both the control group and the experimental group, the average of the highest pain sensation was experienced on the 2nd day. The difference between the groups was not statistically significant (Table 3).

The pain ceased much sooner in the experimental group than in the control group. For the control group, on average, the pain disappeared on the 7th day. For the experimental group, on average, the pain disappeared on the 5th day. A statistically significant difference was seen between the two groups (Table 4).

The graph revealed a significant difference between the two groups. The average onset of pain in the experimental group (16.10 hours) was significantly reduced when compared with the control group (3.10 hours).

DISCUSSION

Pain is a highly unpleasant physical sensation. The fear of pain is the prime cause that patients with malocclusions are apprehensive in receiving orthodontic treatment. Painless dental procedures help in motivating patients to seek orthodontic treatment. Various methods, invasive and noninvasive, have been introduced to reduce pain caused by dental treatments.

Low-level laser therapy has been used for more than three decades of international experimental and

Table 3: Sample distribution according to severe pain experienced (most painful day)

	Control n (%)	Experimental n (%)
Serious pain day		
Day 1	4 (40)	1 (10)
Day 2	6 (60)	5 (50)
Day 3	0 (0)	4 (40)
Total	10 (100)	10 (100)

Table 4: Sample distribution according to pain disappearance

	Control n (%)	Experimental n (%)
Pain disappear day		
Day 5	0 (0)	6 (60)
Day 6	4 (40)	4 (40)
Day 7	6 (60)	0 (0)
Total	10 (100)	10 (100)

clinical research. No true side effects of using the low-level laser light have been found. When low-level laser light provides the energy that interacts with our cells, it creates a myriad of positive functions, such as accelerated wound healing, pain relief, regeneration, and immune enhancement. It is noninvasive, nonpharmaceutical, and economical. These benefits may help generate interest among more clinicians, for improving health services and treatment outcomes.

The effect of single LLLT on the perception of pain by patients having orthodontic treatment with fixed appliances was investigated after the placement of superelastic NiTi wire as the initial archwire.

Studies on pain relief by LLLT include fixed orthodontic treatment and other fields, such as temporomandibular joint pain, aphthae and hypersensitivity.^{8,9}

It has been proven that LLLT penetration is more effective than the visible laser.^{10,11} The transmission of laser through tissue is highly wavelength specific and is optimal in the optical window of 500 to 1200 nm. Several authors have used different wavelengths within this optical window in a range of 670 to 830 nm.^{5,7,12} We have used class I GaAs low-level laser with a wavelength of 840 nm and a mean output of 30 mW.

Laser irradiation affects till a certain range of distance; therefore, irradiation of the entire area is not required to obtain the desired effects.¹¹ Therefore, certain points were chosen for the laser application in this study. Based on this, laser applications were performed on both the buccal and lingual sides to the cervical, middle, and apical thirds.

The minimal application time for LLLT efficacy is 2 to 3 minutes per tooth.¹¹

Pain perception differs from patient to patient.¹² However, the significance level of $p < 0.05$ has been proved to be a statistically significant correlation between LLLT and pain reduction.

A gradual increase in pain has been observed during fixed orthodontic treatment from the 4th to the 24th hour but normalizes by the 7th day. The patients who have higher perceptions of the severity of their malocclusions are more cooperative and seemed to adapt faster. They have less pain during orthodontic treatment compared with other patients.

Previous studies conducted to assess the efficacy of LLLT on reduction of pain did not quantify the crowding to standardize the sample selection. Therefore, the correlation of pain and amount of crowding was not possible.⁷ In this study, we have standardized the patients based on lower anterior crowding. Patients with moderate-to-severe anterior crowding with Little's Irregularity Index score of 4 to 9 (moderate-severe irregularity) were selected.¹³ Previous studies have proved that the lower arches have a higher pain perception when compared with the upper arches.¹⁴ Furthermore, the pain perceived after placement of the initial aligning archwires is greater in the anterior teeth than in the posterior teeth.¹⁵

Pain is perceived after the placement of NiTi archwires for initial alignment and is unbiased to the diameter of the initial archwires. All the patients in this study received 0.016 super elastic NiTi archwires as their initial archwire. Studies have proved that the difference in pain perceived after insertion of 0.014 and 0.016 NiTi archwires was not statistically significant.¹⁵

The average onset of pain in the experimental group (16.10 hours) was significantly reduced when compared with the control group (3.10 hours). The significance level of $p < 0.001$ showed a statistically significant difference between the two groups (Table 2 and Graph 1). Similar results were found in previous studies. Table 2 summarizes higher standard deviation for the experimental group for the onset of pain. This was because two patients experienced pain later than the others in this group. This increased the SD in this group.

The most painful day was similar for both the groups. For both, the control group and the experimental group, the average of the highest pain sensation occurred between 24 and 48 hours (Table 3).

The pain ceased much sooner in the experimental group than in the control group. For the control group, on average, the pain disappeared on the 7th day. For the experimental group, on average, the pain disappeared

on the 5th day (Table 4). These findings are similar to the results of previous studies on the effect of LLLT in controlling pain.^{11,12}

Several studies state that pain reduction in orthodontic treatment should be achieved without analgesics, as NSAIDs can affect tooth movement. The LLLT is a non-invasive technique to achieve analgesia. It is also easy to administer and has not shown any adverse tissue reactions.

CONCLUSION

The LLLT was an effective and noninvasive method for pain reduction in orthodontic patients after receiving their first archwires. The duration and intensity of pain reduced with the application of LLLT.

- LLLT clearly reduced the average onset of pain in the experimental group (16.10 hours) when compared with the control group (3.10 hours).
- The most painful day was similar for both the groups.
- The pain ceased much sooner in the experimental group than in the control group. For the control group, on average, the pain disappeared on the 7th day. For the experimental group, on average, the pain disappeared on the 5th day.

REFERENCES

1. Polat O, Karaman AI, Durmus E. Effects of preoperative ibuprofen and naproxen sodium on orthodontic pain. *Angle Orthod* 2005 Sep;75(5):791-796.
2. Young AN, Taylor RW, Taylor SE, Linnebur SA, Buschang PH. Evaluation of preemptive Valdecoxib therapy on initial archwire placement discomfort in adults. *Angle Orthod* 2006 Mar;76(2):251-259.
3. Sergl HG, Klages U, Zentner A. Pain and discomfort during orthodontic treatment: causative factors and effects on compliance. *Am J Orthod Dentofac Orthop* 1998 Dec;114(6):684-691.
4. Ngan P, Wilson S, Shanfeld J, Amini H. The effect of ibuprofen on the level of discomfort in patients undergoing orthodontic treatment. *Am J Orthod Dentofac Orthop* 1994 Jul;106(1):88-95.
5. Lim HM, Lew KK, Tay DK. A clinical investigation of the efficacy of low level laser therapy in reducing orthodontic postadjustment pain. *Am J Orthod Dentofac Orthop* 1995 Dec;108(6):614-622.
6. Mehta GD, Bhad-Patil WA. Efficacy of low-intensity laser therapy in reducing treatment time and orthodontic pain: a clinical investigation. *Am J Orthod Dentofac Orthop* 2012 Mar;141(3):289-297.
7. Tortamano A, Lenzi DC, Haddad AC, Bottino MC, Dominguez GC, Vigorito JW. Low-level laser therapy for pain caused by placement of the first orthodontic archwire: a randomized clinical trial. *Am J Orthod Dentofac Orthop* 2009 Nov;136(5):662-667.
8. Gorur I, Orhan K, Can-Karabulut DC, Orhand AI, Ozturk A. Low-level laser therapy effects in traumatized permanent teeth with extrusive luxation in an orthodontic patient. *Angle Orthod* 2010 Sep;80(5):968-974.

9. Genovese MD, Olivi G. Use of laser technology in orthodontics: hard and soft tissue laser treatments. *Eur J Paediatr Dent* 2010 Mar;11(1):44-48.
10. Karu TI. Molecular mechanism of the therapeutic effect of low intensity laser radiation. *Laser Life Sci* 1988;2(1): 53-74.
11. Harazaki M, Isshiki Y. Soft laser irradiation induced pain reduction in orthodontic treatment. *Bull Tokyo Dent Coll* 1997 Nov;38(4):291-295.
12. Turhani D, Scheriau M, Kapral D, Benesch T, Jonke E, Bantleon HP. Pain relief by single low-level laser irradiation in orthodontic patients undergoing fixed appliance therapy. *Am J Orthod Dentofac Orthop* 2006 Sep;130(3):371-377.
13. Little RM. The irregularity index: a quantitative score of mandibular anterior alignment. *Am J Orthod* 1975 Nov;68(5):554-563.
14. Fernandes LM, Ogaard B, Skoglund L. Pain and discomfort experienced after placement of a conventional or a superelastic NiTi aligning archwire. A randomized clinical trial. *J Orofac Orthop* 1998 Feb;59(6):331-339.
15. Erdinc AM, Dincer B. Perception of pain during orthodontic treatment with fixed appliances. *Eur J Orthod* 2004 Feb;26(1):79-85.