

# Efficacy of Soft Tissue Diode Laser on pain reduction induced by Elastomeric Separators: A Clinical Investigation

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## ABSTRACT

**Introduction:** Initiation of fixed orthodontic treatment is always associated with a severe pain almost after 24 hours of separators placement, patients have reported disturbed sleep and inability to eat due to this pain. Recently, many studies have shown promising results by use of low-level laser therapy (LLLT) to control dental pain. **Objective:** The aim of this clinical investigation was to analyze the effect of soft tissue diode laser on the perception of pain after placement of elastomeric separators. **Materials and method:** In twenty five patients who reported to Department of Orthodontics & Dentofacial Orthopedics for fixed orthodontic treatment, elastomeric separators were placed on the all first molars. First molars were irradiated for 30 seconds every 24 hours for 72 hours using Medical Diode Laser System- 980nm/ 10 w (unicorn), model DEN 10 B. Pain was marked by the patient on a visual analog scale at predetermined intervals. **Results:** From the time of insertion of separators to over a period of 72 hours the, there was no significant change in pain score in laser irradiated quadrants as compared to non-irradiated control side. **Conclusion:** Soft tissue diode laser irradiation did not decrease the perception of pain to a significant level throughout a period of 72 hours after separator placement as compared with pain perception in control quadrants.

**KEYWORDS:** Low Level Laser Therapy (LLLT), Pain perception, Elastomeric separators

## INTRODUCTION

Unlike in other specializations of dentistry, patient reports to an orthodontic clinic with as such no acute pain or discomfort. Mostly patient expects an improvement of dentofacial esthetics and masticatory function with minimal discomfort. The first step with the initiation of fixed orthodontic treatment is separator placement. Studies have reported the severity of initial orthodontic pain to be worse than an extraction.<sup>1</sup> In various studies, the peak in this pain was reported within 24 hours of the separator or initial wire placement.<sup>2,3</sup> In a study carried out among 203 Chinese adult orthodontic patients, 91% of patients experienced a transient pain from teeth whereas in 39% of these patients with each new archwire or elastic force application the discomfort to teeth was experienced.<sup>4</sup> Inducing a severe pain with the start of an fixed orthodontic treatment sometimes may lead to discontinuation of the treatment by the patient.

Different theories have been proposed since long to explain orthodontic pain mechanism, and along with it, methods have been developed to control this pain. For the similar quest a study was carried out to correlate pain after placement of orthodontic elastic separators and the possible associations with the gingival crevicular fluid (GCF) composition changes in the level of interleukin 1-beta (IL-1 $\beta$ ), substance P (SP), and prostaglandin-E2

(PGE2) and they concluded a rapid release of biochemical markers that peaked after 1 day and partially decreased 7 days later. The similar pattern was seen in the intensity of pain associated.<sup>5</sup>

The common method implicated in the day to day practice to relieve this pain includes the use of nonsteroidal anti-inflammatory drugs (NSAIDs). Ngan *et al.* conducted a study to evaluate the analgesic efficacy of ibuprofen and aspirin. They found ibuprofen to be more effective in relieving separator induced pain than aspirin.<sup>6</sup> With the recent studies published the use of NSAIDs have their potential influence on tooth movement along with adverse systemic side effects.<sup>7,8</sup> Hwang *et al.* (2004) used Thera-bite ® wafers and Marie *et al.* (2003) studied use of vibratory stimulation as a method of reducing pain after orthodontic appliance but in both results were not so promising.<sup>9,10</sup>

In last few years a lot of literature has been published on the use of low-level laser therapy (LLLT) for orthodontic pain control. Researchers have advocated the use of laser therapy as an analgesic with many clinical implications. The analgesic effect of laser therapy may be attributed to its anti-inflammatory and neuronal effect.<sup>11-14</sup> Verschueren *et al.* (1975) concluded that (LLLT) generates a photobioactive reaction (PAR) to stimulate

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cellular proliferation and differentiation which leads to increased local blood circulation that removes the pain-inducing inflammatory mediators and enhances the cellular activities.<sup>15, 21</sup>

There have been various studies in past focusing on the effect of LLLT on overall orthodontic pain control over a longer duration of time. Thus, the purpose of this study was to evaluate the efficacy of soft tissue diode laser on pain reduction induced only by elastomeric separators over a period of 72 hours within which the purpose of separators is served.

## MATERIAL & METHODS

For this study approval was taken from institutional review board.

**Subjects:** A total of twenty five orthodontic patients who were scheduled to receive fixed orthodontic treatment agreed to participate in this study. Patient's detailed medical history was taken. Both the parents and the patients were informed about the procedure, and informed consent was obtained.

**Selection Criteria:** The following selection criteria were applied for participation:

- No history of previous orthodontic treatment.
- No Significant Medical history.
- All teeth to second molars were fully erupted.
- No evident periodontal or gingival problems.
- No use of any analgesics during the period of study.

**Methodology:** Elastomeric separators (Figure: 1) were placed at the mesial & distal contacts of maxillary and mandibular first molars in twenty five patients in this study. Right maxillary and mandibular first molars were stimulated with LASER (Figure: 2). Radiation of 1.2 W output in continuous mode was applied for 10 seconds each at 3 specified points for a total duration of 30 seconds (Figure: 3).

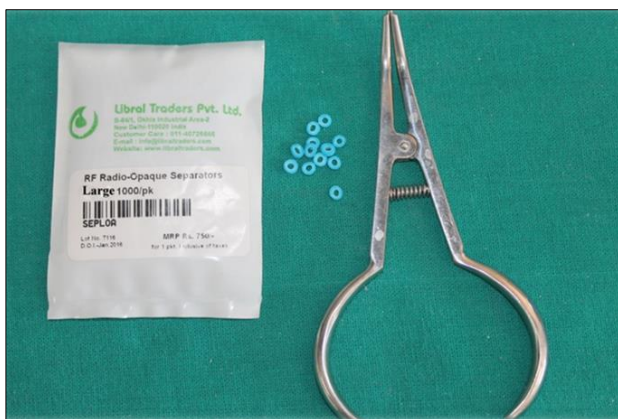


Figure 1: Large elastomeric separators and separator placing plier.

Only right maxillary and mandibular molars were irradiated whereas, left maxillary and mandibular molars served as control. Three specific points were stimulated in right maxillary & mandibular molars on buccal side. Similarly, these three specific points were stimulated



Figure 2: Medical Diode LASER System- 980nm/ 10 w (unicorn), model DEN 10 B

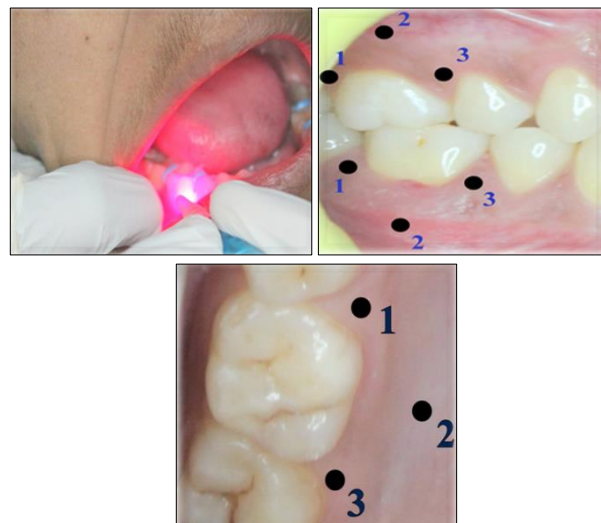


Figure 3: Radiation of 1.2 W output in continuous mode was applied for 10 seconds each at marked 3 specific points buccally in right upper & lower molars. Similarly Palatally and lingually marked three specific points were stimulated.

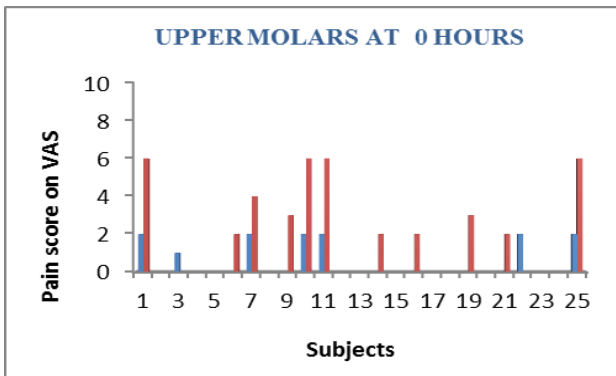
palatally and lingually as well. LASER stimulation was done at 0 hours, 24 hours & 48 hours after separator placement. All twenty five patients were instructed to mark their level of pain tooth wise on a 10 cm visual analog scale (VAS) at 0 hours, 24 hours & 48 hours of separator placement. The VAS scale with a 0-10 score reading, where 0 indicate minimal or no pain and 10 indicates the highest or worst possible pain. Patients were instructed not to take any additional analgesics during the course of the study.

**Statistical Analysis:** The readings were tabulated and were subject to unpaired 't' test for statistical analysis.

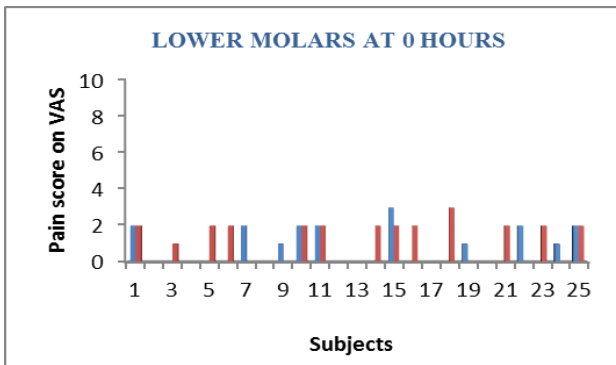
## RESULTS

There was no statistically significant difference ( $P=0.137$ ) in pain perception immediately after separator placement in both irradiated & non radiated first molars. Similarly, no statistically significant difference ( $P=0.130$ ) in pain perception after 24 hours of separator placement

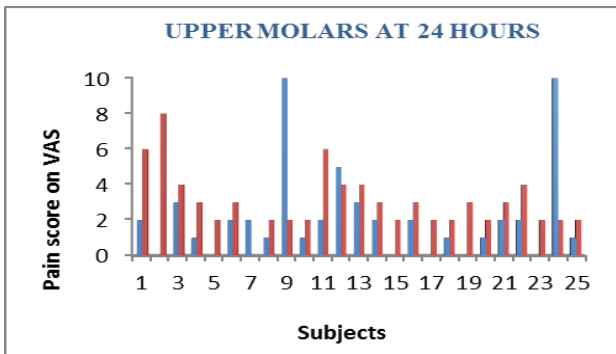
in both irradiated & non radiated first molars was recorded. Though there was an increase in pain perception after 24 hours of separator placement in tooth irradiated with LASER (Graphs 1-6).



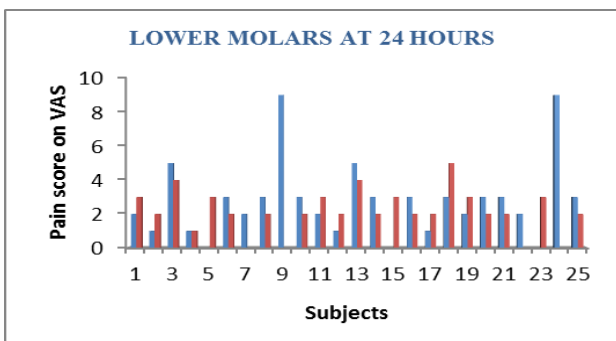
Graph 1: Comparison of pain perception level between irradiated and non-radiated upper molars at 0 Hrs.



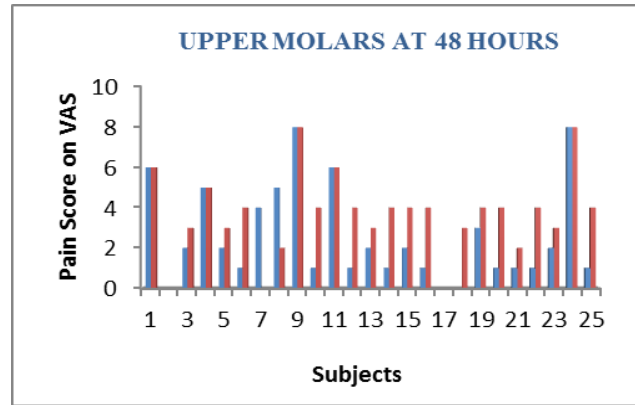
Graph 2: Comparison of pain perception level between irradiated and non-radiated lower molars at 0 Hrs.



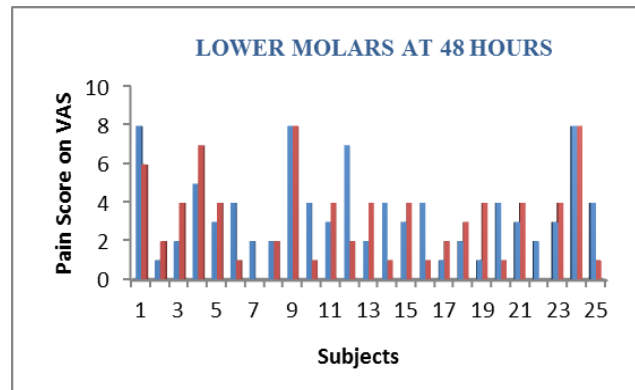
Graph 3: Comparison of pain perception level between irradiated and non-radiated upper molars at 24 Hrs.



Graph 4: Comparison of pain perception level between irradiated and non-radiated lower molars at 24 Hrs.



Graph 5: Comparison of pain perception level between irradiated and non-radiated upper molars at 48 Hrs.



Graph 6: Comparison of pain perception level between irradiated and non-radiated upper molars at 48 Hrs.

■ Right (Laser)  
■ Left (Control)

## DISCUSSION

Mechanical force is the key factor of orthodontic treatment. During fixed treatment, mechanical force is applied through brackets and arch wires, which moves teeth slowly in the alveolar bone. However, this force also results in compression of periodontal ligaments and subsequently induces ischemia, inflammation, and edema in these periodontal tissues.<sup>16</sup>

During this inflammatory response, noxious agents such as prostaglandins, histamine, serotonin, and substance P are released from nerve endings, which then cause pain.<sup>17,18</sup> Patients can experience an acute pain immediately after the placement of separators, or patients express “medium pain” for 1–2 days in each appointment every 4–6 weeks.<sup>19</sup> Among Orthodontists, NSAIDs remain the most preferred method for pain relief. However, adverse effects are very common as reported. Besides common drug side effects, it has been also found that NSAIDs significantly inhibited the extracellular collagen remodeling activity by suppressing the release of prostaglandins, and then cause a reduction in tooth movement velocity.<sup>20,21</sup>

For the sake of drug adverse effects and the expense of a reduction in the rate of tooth movement, NSAIDs might



not be an ideal choice for pain control for orthodontic patients. Thus, LLLT may be a better choice than NSAIDs. The application of low-level lasers in the field of dentistry has been available for nearly 4 decades<sup>22,23</sup>. LLLT activates both local microcirculation and cellular metabolism, and produces anti-inflammatory and regenerative effects.<sup>24,25</sup>

In vitro studies have shown LLLT to inhibit the production of inflammatory factors and pain-related neurotransmitters.<sup>26</sup> Furthermore, LLLT is found to combat pain by accelerating the removal of pain-inducing substances like substance P, histamine, dopamine, and prostaglandins; and decrease pain through the reduction of PGE2 levels and the inhibition of cyclooxygenase-2.<sup>27,28</sup> There also has been several clinical trials regarding the pain relief ability of LLLT in orthodontic treatment, but results varied among different studies.

With the aim of this study to evaluate the effect of frequent laser irradiation on the perception of pain after separator placement it was found in agreement with previous studies that pain reached a maximum level 24 hours after separator placement.<sup>29,30,31</sup>

Lim et al. (1995) & Esper et al. (2011) carried out similar studies to investigate the efficacy of LASER therapy on orthodontic pain control and concluded that there was no significant reduction in pain by LASER; similar findings were noted in the present study also with no significant difference in pain perceptions on laser & non laser sites.<sup>22, 32</sup>

Fujiyama et al. (2008) used CO<sub>2</sub> LASER to control the orthodontic pain and concluded that pain reached a maximum level by 24 hours after separator placement. The same finding was devised in this study. As such there was no difference in pain perception in upper and lower molars.<sup>30</sup>

Pinheiro et al. (1997) while studying the use of LLLT in the management of disorders of the maxillofacial region reported that LASER irradiation improve the peripheral circulation, oxygenate hypoxic cells, and help remove noxious products. There are also reports on the effect of LLLT in inhibiting the production of inflammatory mediators, such as prostaglandin E2 and interleukin-1.<sup>33</sup>

Considering that the various studies which have been published or being carried out to establish the use of LASER for control of orthodontic pain perception utilize different types of LASER, different duration of irradiation, different area of stimulation and different varying wave length & power specifications. Thus still there is a need to establish the exact specifications for the use of LASER in orthodontic pain control.

## CONCLUSION

Under the limitations of this study, no significant reduction in orthodontic pain was achieved by the use of soft tissue diode LASER stimulation. Though it was established that maximum pain threshold was seen at 24-

48 hours of separator placement with minimal or no pain at the immediate placement of separators. Thus we conclude that the laser stimulation with used power specifications and mode of application is not efficacious in reducing pain perception after separator placement. Further research in the field by use of different laser systems and specifications is required to confirm the findings.

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