

Evaluation of level of IL-6 in gingival crevicular fluid during orthodontic tooth movement using diode laser

Running title: Orthodontic tooth movement with laser

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Abstract

Objectives: Evaluation of orthodontic tooth movement (OTM) with diode laser and level of IL-6 in gingival crevicular fluid (GCF).

Materials and Method: Present study consisted of 20 patients who were exposed to diode laser at baseline, day 15, 30, and 60 during the canine retraction phase. The amount of tooth movement and level of IL-6 was evaluated and compared at various tooth movement stages.

Results: Canine retraction phase in stage 0 in group I was 2.12 ± 0.11 , in group II was 2.14 ± 0.13 , at stage 1 in group I was 2.24 ± 0.15 and in group II was 2.20 ± 0.11 , at stage 2 was 1.54 ± 0.28 in group I and 1.62 ± 0.13 in group II, at stage 3 was 1.46 ± 0.21 in group I and 1.46 ± 0.14 in group II. The difference between both groups was non-significant ($P > 0.05$). Mean \pm SD IL-6 level (pg/mL) in stage 0 in group I was 0.05 ± 0.02 , in group II was 0.06 ± 0.02 , at stage 1 in group I was 0.21 ± 0.16 and in group II was 0.13 ± 0.45 , at stage 2 was 0.5 ± 0.28 in group I and 0.5 ± 0.36 in group II, at stage 3 was 0.78 ± 0.42 in group I and 0.49 ± 0.27 in group II. The dissimilarity among both groups was non-significant ($P > 0.05$).

Conclusion: It was concluded that diode laser found to enhance the orthodontic tooth movement. The level of IL-6 was higher in laser side as in comparison to control

Key words: Canine retraction, interleukin 6, Orthodontic, tooth movement

Introduction

Orthodontic treatment usually takes time duration of 2-3 years depending malocclusion status.¹ Presence of orthodontic bands and brackets poses patients to periodontal breakdown, dental caries and external root resorption.² However, these complications may be minimized by accelerating tooth movements.³ Several studies have shown that several agents such as prostaglandin E2 can result in mild pain following alveolar bone injections.⁴ These agents also affect body metabolism.⁵

Various studies shown that LLLI promotes OTM without causing deleterious effect on teeth.⁶ It is evident that certain cytokines such as interleukin 1 (IL-1), IL-2, IL-6, and IL-8 etc. level increases significantly during OTM.⁷ Hence the present study was done to assess the level of IL and orthodontic tooth movement using diode laser.

Materials & Methods

The present study was performed on 20 adult patients in the department of Orthodontics after obtaining attaining ethical clearance and informed consent was attained. Subjects were included after considering the inclusion and exclusion criteria.

To standardize the procedure initial oral prophylaxis was done to all participants. Alginate impressions were made and casts were poured with dental stone. For bonding, a 0.022 × 0.028" edgewise appliance was used and 0.032" SS wire transpalatal bar was used for posterior anchorage.

First premolars were extracted. Canine retraction was done with NiTi closed coil springs on rectangular SS wires. Laser irradiation with 980-nm diode gallium-aluminum-arsenide diode laser (GaAlAs) emitting with an output power of 100 mW, dose of 5.6 J/cm² operating in a continuous-wave mode was used. One maxillary quadrant served as laser side (group I) and other as control side (group II). 3 laser exposures were made from buccal and 3 from palatal side. The exposure time was 10 seconds for cervical and middle third and 8 seconds for the apical third of the tooth. Laser irradiation was performed at baseline, 1 week, 2 weeks, 3 weeks, and 4 weeks every month during canine retraction phase.

Dental casts were again made end of the aligning and leveling phase, on 3rd week during canine retraction and at the end of this phase. The distance (mm) from canine tip to tip of the mesiobuccal cusp of the first molar was measured with vernier caliper. The velocity of the movement was calculated as: $V = d/t$.

In all patients, GCF samples were collected at baseline (stage 0) on the day of treatment, and before placing the wire for alignment. Stage 1 sample was obtained at the end of alignment and leveling phase. GCF was obtained on the 3rd week of each month before laser irradiation and reactivation of the appliance (stage 2–5) during the canine retraction.

Paper strips (0.2 X 1 cm) were inserted into maxillary gingival crevice for collection of GCF, left for 60 seconds and removed. These strips were transferred into 1.5-ml sterile tubes containing 250-µl phosphate-buffered saline. The level of IL-6 (pg/mL) in each sample was calculated.

Statistical analysis

For statistical analysis, results were aggregated, entered in MS excel sheet and studied using SPSS version 21.0 (Chicago, IL, USA). Various statistical methods such as Kolmogorov-Smirnov and Wilcoxon signed-rank test was used of the study. P value less than 0.05 was labeled as significant.

Results

Table 1 shows that mean± SD distance (mm) parameter in the canine retraction phase in stage 0 in group I was 2.12± 0.11, in group II was 2.14± 0.13, at stage 1 in group I was 2.24± 0.15 and in group II was 2.20± 0.11, at stage 2 was 1.54± 0.28 in group I and 1.62± 0.13 in group II, at stage 3 was 1.46± 0.21 in group I and 1.46± 0.14 in group II. The difference between both groups was non- significant (P> 0.05).

Table 2 shows that mean retraction velocity of the canine tooth in group I (laser side) was 0.013 and in group II (control side) was 0.012. The difference was significant (P< 0.05).

Table 3 shows that mean± SD IL- 6 level (pg/mL) in stage 0 in group I was 0.05± 0.02, in group II was 0.06± 0.02, at stage 1 in group I was 0.21± 0.16 and in group II was 0.13± 0.45, at stage 2 was 0.5± 0.28 in group I and 0.5± 0.36 in group II, at stage 3 was 0.78± 0.42 in group I and 0.49± 0.27 in group II. The dissimilarity among both groups was non- significant (P> 0.05).

Table 1: Evaluation of canine retraction phase

Time interval	Group I	Group II	P value
Baseline (Stage 0)	2.12± 0.11	2.14± 0.13	0.82
The end of leveling and aligning phase (Stage 1)	2.24± 0.15	2.20± 0.11	0.76
The end of third month of canine retraction (Stage 2)	1.54± 0.28	1.62± 0.13	0.82
The end of fourth month of canine retraction (Stage 3)	1.46± 0.21	1.46± 0.14	1

Table 2: Retraction velocity of the canine tooth in both groups

Groups	Mean	P value
Group I	0.013	0.01
Group II	0.012	

Table 3: Evaluation of IL-6 levels in both groups

Time interval	Group I	Group II	P value
Baseline (Stage 0)	0.05± 0.02	0.06± 0.02	1
The end of leveling and aligning phase (Stage 1)	0.21± 0.16	0.13± 0.45	0.08

The end of third month of canine retraction (Stage 2)	0.5± 0.28	0.5± 0.36	1
The end of fourth month of canine retraction (Stage 3)	0.78± 0.42	0.49± 0.27	0.06

Discussion

Orthodontic tooth movement (OTM) is initiated by alveolar bone remodeling depending on force on pressure side.⁸ Periodontal ligament is greatly influenced by mechanical stimuli leading to OTM. It is demonstrated in studies that cytokines such as interleukin1 (IL-1), IL-2, IL-6, and IL-8, also known as proinflammatory cytokines bring about apposition-resorption process of the bone.⁹ During OTM, the level of IL-6 is increased in GCF.¹⁰

Yassaei et al¹¹ assessed level of IL- 6 in GCF and used diode laser to determine its role in OTM and there was definitely a tendency for more canine retraction in the LLLI, but the results failed to show any significant difference between the mean rate of canine retraction of both groups (P= 0.068). Limpanichkul et al¹² suggested that the amount of absorbed energy by the tissues had an effect on the tissue response to LLLI.

Ren et al¹³ found significant higher levels of pro-inflammatory cytokines such as IL-6 and IL-1 β in the early stage of tooth movement. Further studies are required to evaluate the effectiveness of diode laser in orthodontic tooth movement with larger sample size.

Conclusion

Authors found that diode laser found to increase the orthodontic tooth movement. The level of IL- 6 was higher in laser side as compared to control side but the difference was non- significant.

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References

1. Davidovitch Z. Tooth movement. *Crit Rev Oral Biol Med* 1991; 2: 411–450.
2. Başaran G, Özer T, Kaya FA, Hamamci O. Interleukins 2, 6, and 8 levels in human gingival sulcus during orthodontic treatment. *Am J OrthodDentofacOrthop* 2006; 130: 6- 21.
3. Kumar, S. (2022). A quest for sustainium (sustainability Premium): review of sustainable bonds. *Academy of Accounting and Financial Studies Journal*, Vol. 26, no.2, pp. 1-18
4. Allugunti, V.R. (2019). Diabetes Kaggle Dataset Adequacy Scrutiny using Factor Exploration and Correlation. *International Journal of Recent Technology and Engineering*, Volume-8, Issue-1S4, pp 1105-1110.
5. Viswanatha KKRC, Reddy A, Elango N M (2019). Diabetes Kaggle Dataset Adequacy Scrutiny using Factor Exploration and Correlation, *International Journal of Recent Technology and Engineering (IJRTE)* Vol. 8.
6. Uematsu S, Mogi M, Deguchi T. Interleukin (IL)-1β, IL-6, tumor necrosis factor-α, epidermal growth factor, and β2- microglobulin levels are elevated in gingival crevicular fluid during human orthodontic tooth movement. *J Dent Res* 1996; 75:562–567.
7. Ren Y, Hazemeijer H, de Haan B, Qu N, de Vos P. Cytokine profiles in crevicular fluid during orthodontic tooth movement of short and long durations. *J Periodontal* 2007; 78:453–458 23.
8. Van Gastel J, Teughels W, Quirynen M, Struyf S, Van Damme J, Coucke W, Carels C. Longitudinal changes in gingival crevicular fluid after placement of fixed orthodontic appliances. *Am J OrthodDentofacOrthop* 2011; 139:735–744.
9. Perinetti G, Paolantonio M, D’Attilio M, D’Archivio D, Tripodi D, Femminella B, Spoto G. Alkaline phosphatase activity in gingival crevicular fluid during human orthodontic tooth movement. *Am J OrthodDentofacOrthop* 2002; 122:548–555.
10. Lee KJ, Park YC, Yu HS, Choi SH, Yoo YJ. Effects of continuous and interrupted orthodontic force on interleukin-1β and prostaglandin E 2 production in gingival crevicular fluid. *Am J OrthodDentofacOrthop* 2004; 125:168–177.
11. Dudic A, Kiliaridis S, Mombelli A, Giannopoulou C. Composition changes in gingival crevicular fluid during orthodontic tooth movement: comparisons between tension and compression sides. *Eur J Oral Sci* 2006; 114:416–422.
12. Tuncer BB, Özmeriç N, Tuncer C, Teoman I, Çakilci B, Yücel A, Balos K. Levels of interleukin-8 during tooth movement. *Angle Orthod* 2005; 75:631–636.
13. Hirano T, Akira S, Taga T, Kishimoto T. Biological and clinical aspects of interleukin 6. *Immunol Today* 1990; 11:443–449 39.
14. Yassaei S, Aghili H, Afshari JT, Bagherpour A, Eslami F. Effects of diode laser (980 nm) on orthodontic tooth movement and interleukin 6 levels in gingival crevicular fluid in female subjects. *Lasers in medical science*. 2016 Dec 1;31(9):1751-9.

15. Limpanichkul W, Godfrey K, Srisuk N, Rattanayatikul C. Effects of low-level laser therapy on the rate of orthodontic tooth movement. *OrthodCraniofac Res* 2006; 9:38–43.
16. Ren Y, Hazemeijer H, de Haan B, Qu N, de Vos P. Cytokine profiles in crevicular fluid during orthodontic tooth movement of short and long durations. *J Periodontal* 2007; 78:453–458.