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Original Research Article

Evaluation of effectiveness of low level laser therapy in accelerating orthodontic tooth movement-An in vivo study

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ABSTRACT

Objective: To assess the acceleration of tooth movement in canine retraction and to assess the interleukin 1β level in Gingival Crevicular Fluid.

Materials and Methods: 0.022 slot MBT brackets, 0.018 inch stainless steel arch wire, Low level laser (Gallium-Aluminium-Arsenide Laser), ELISA kit, Micro-capillary tube, Digital Vernier calliper, Dontrics gauge, NiTi closed coil springs Open labelled split mouth, non-experimental interventional institutional based study. By coin toss method, each of the participant's mouth was randomly assigned either to the laser therapy (group 1) and 40 reference sites (group 2). On the experimental site orthodontic treatment with fixed appliance, a combination with low level laser therapy (Gallium-Aluminium-Arsenide laser) to the canine on the days 3,7,14 and then every 15 days for 2 months was initiated. Then 5μL of Gingival Crevicular Fluid (GCF) was collected to analyse the interleukin 1β levels using the ELIZA kit. The measurements were made with the help of a digital Vernier calliper.

Results: The laser group showed a significant greater reduction in the canine to molar distance than the site treated with conventional technique. The interleukin 1 β levels raised significantly for the site treated with laser as compared to the other. We observed that: Increased inflammatory response in the form of raised interleukin levels and Faster distalization of the canine when adjunct with low level soft tissue laser.

Statistical analysis: The entire data was statistically analyzed using Statistical Package for Social Sciences (SPSS version 21.0, IBM Corporation, USA) for MS Windows. In Statistics, unpaired t-test is a used to compare equality of two population means and F-test is used to compare the equality of two population variance using that the samples were drawn from different populations.

Conclusion: There was a clinically appreciable amount of retraction seen resulting in faster space closure between the canine and the first permanent molar in the group that had low level laser than the other group that was treated by the conventional therapy. We also observed a considerable rise in the interleukin 1 β levels in the laser group.

1. Introduction

One of the major challenges to a successful orthodontic treatment especially while dealing with crowding cases type of malocclusion is the prolonged duration of treatment.[1] Prolonged orthodontic management prods a lot of patients, exclusively grown-ups, to either evade treatment or to pursue diminutive alternate elucidations with conceded consequences. Hence there is a continuous search for those types of treatment modalities which without altering the quality outcome of the said intervention are able to render the same in a shorter time span.[2]

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Orthodontists are trying since long to develop certain approach strategies that will actually assist to increase the rate at which the tooth movement takes place during orthodontic treatment.[2,3] The rate of tooth movement per se can be accelerated by administration of drugs such as prostaglandins, electrical stimulations, vitamin D and osteocalcin, use of ultrasound around the sockets in the jaws. The injection method is always accompanied by certain degree of pain as well as discomfort to the patients.[3] So the orthodontists is faced with a challenge of not only completing the treatment faster but also avoiding pain as well as use of user friendly and affordable equipments in the daily practise. With this intention a lot of research has been carried out with relation to Low Level Laser Therapy (LLLT) and it has been reported to be highly useful and successful in different forms of treatment modalities in dentofacial orthopaedics.

Laser lights cause stimulation of the proliferation process of osteoblasts and fibroblasts and regulate the bone remodelling process and in turn accelerate the movement of the teeth.[3,4] An essential component to understand the entire process of bone remodelling is the explanation of the role that cytokines play and reshape the bone. there is a beginning of inflammatory process of the surrounding periodontium, the cytokine bring about pro inflammatory reactions, mainly Tumour necrosis factor, Interleukin 1β and . These three are involved with the procedure involved in the acute inflammation too apart from the metabolism, resorption as well as bone deposition inhibition.

When orthodontic forces are applied, the cytokines create Nitrogen oxide that is a known element for bone remodelling procedure. The production of this oxide requires two enzymes- nitrogen- oxide synthesis and endothelial nitrogen- oxide synthesis. When the gene expression of the two enzymes is activated by an array of pro- inflammatory mediators as well as anti- inflammatory mediators that are released as a response to bone resorption and deposition or repair.[3]

In case the mechanical forces applied are much greater; then the pulpal tissue response is high enough to cause root resorption also. More studies are essential to see if there is actually any shift in these mediators and what role they can play to be used as markers for understanding the effect of lasers on the tooth movements.[5]The pro- inflammatory cytokines are much higher in the tension zone than that of the pressure zone. Also this helps to conclude that these cytokines thus have a role to play in the osteoclastic activities mediated via different pathological pathways. The number of these mediators is definitely higher as compared to that of the control teeth.[4,6]

The aim of this study was to not only evaluate the effect of low level laser therapy on canine movement but also co relate it with the mediators in the GCF (Gingival Crevicular Fluid) and assess if this can be a better alternative to conventional mechanical procedures that are practiced for bringing about accelerated tooth movement in the patient.

Aim

To assess acceleration of tooth movement using low level laser therapy. To assess the acceleration of tooth movement in canine retraction. To assess the interleukin 1β level in Gingival Crevicular Fluid.

2. Materials and Methods

2.1. Materials

1. 0.022 slot MBT brackets
2. 0.018 inch stainless steel arch wire
3. Low level laser (Gallium-Aluminium-Arsenide Laser)
4. ELISA kit
5. Micro-capillary tube
6. Digital Vernier calliper
7. Dontrics gauge
8. NiTi closed coil springs

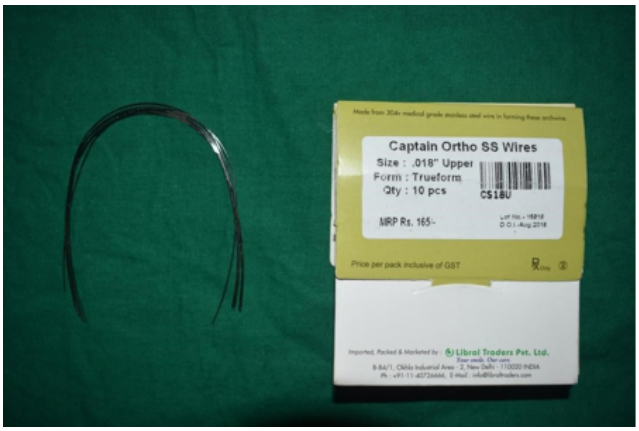


Fig. 1: Stainless steel arch wire

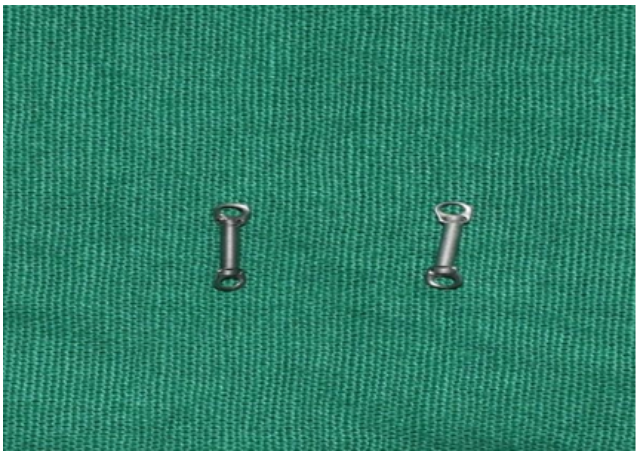


Fig. 2: NiTi closed coil springs

Fig. 3:

2.2. Method

Ethical clearance was obtained from the institutional ethics committee. Type of study: Open labelled split mouth, non-experimental interventional institutional based study.

Sample size

The sample size was calculated using Epi info (version 5) software by Centres for Diseases Control (CDC), U.S.A. The type 1 error was set at 80%, type 2 error was set at 20%, based upon the previous study, the estimated changes in the outcome difference in the laser group was set at 50%. The final sample size was decided to be 80 sites (40 bilaterally induced interventions) among 40 patients.

2.3. Source of the sample

Patients undergoing treatment at the department of Orthodontics who fulfil the inclusion and exclusion criteria.

2.4. Inclusion criteria

Age: 19 to 30yrs, Presence of maxillary permanent teeth, Moderate crowding in anterior maxilla-indicating extraction of two first premolars, No previous orthodontic treatment, No systemic disease, Good oral hygiene. Exclusion criteria: Patients who are minors or above 30 years, Patients with periodontal diseases or any other systemic illness or pregnancy, Patients reporting the use of any medications like on hormone therapy or steroids, Those who refuse to participate in the study.

2.5. Methodology

After the patient selection, a written informed consent was obtained from all the participants. All ethical norms as per the Helsinki guidelines for human experiments were followed. By coin toss method, each of the participant's mouth was randomly assigned either to the laser therapy (group 1) and 40 reference sites (group 2), where only NiTi closed coil spring was used for canine retraction by the conventional method without any additional laser therapy.

The initial alignment was done using NiTi wires and 0.022 slot MBT bracket. A 0.018 inch passive stainless steel archwire with molar stops placed mesial to maxillary molars was used for retracting canine using NiTi closed coil spring in reference and experimental site with a force of 150 gms which was measured using a dontrics gauge. On the experimental site orthodontic treatment with fixed appliance, a combination with low level laser therapy (Gallium-Aluminium-Arsenide laser) to the canine on the days 3,7,14 and then every 15 days for 2 months was initiated.[7] The laser had a wavelength of 940nm, energy density was 80 Joules/cm ^{2} and power output was 100 mW that was applied to the root of canine bucally and palatally. The laser was applied at 5 points immediately after the spring attachment for 15 seconds.[8]

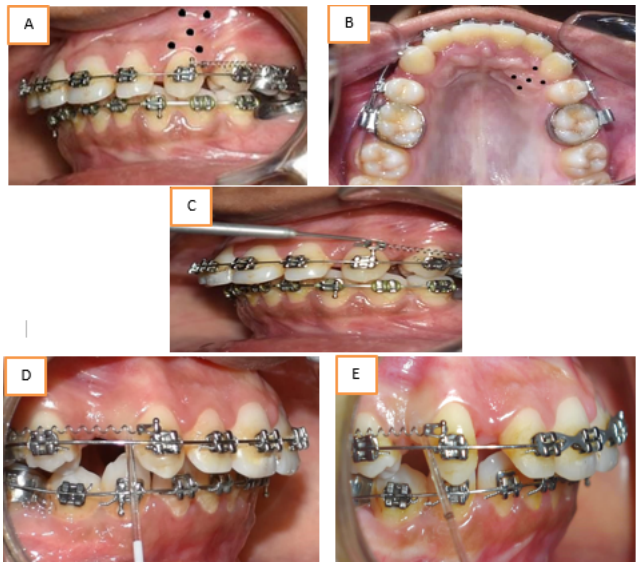


Fig. 4: A: Laser application points on the buccal side; **B :** Laser application points on the palatal side; **C :** Force of 150 gms measured using dontrix gauge; **D:** Collection of GCF before retraction is initiated Collection; **E**: Collection og GCF after 2 months of initiaiton of retraction

Then 5μL of Gingival Crevicular Fluid (GCF) was collected using a calibrated microcapillary tube from the distal sites of the canines in both the groups and transferred to transport media containing phosphate buffer saline (PBS) which was kept in a box containing dry ice. The collection of GCF was done at baseline and then after 2 months. The GCF was sent to the laboratory to analyse the interleukin 1β levels using the ELIZA kit.

2.6. Analysis of the rate of orthodontic tooth movement

The pre and post retraction cast models were prepared. The tips of the canine and that of the mesiobuccal cusp of the first molar on each quadrant were considered to be the points of reference. The measurements were made with the help of a digital Vernier calliper. The pre and post measurements were compared to see if any difference in the tooth movement was observed across both the groups.

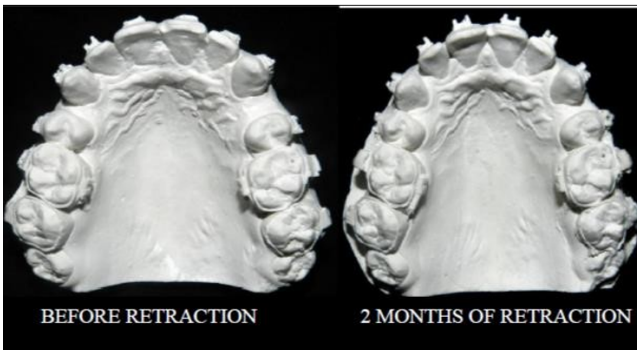


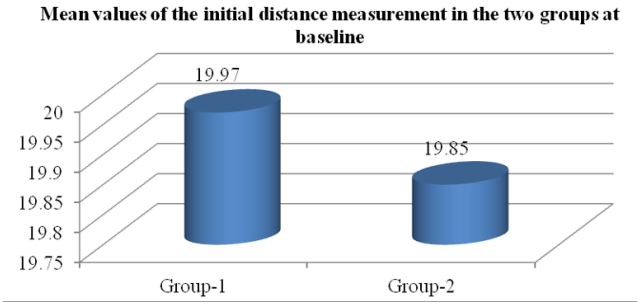
Fig. 5: Dental casts before and after retraction

2.7. Statistical analysis

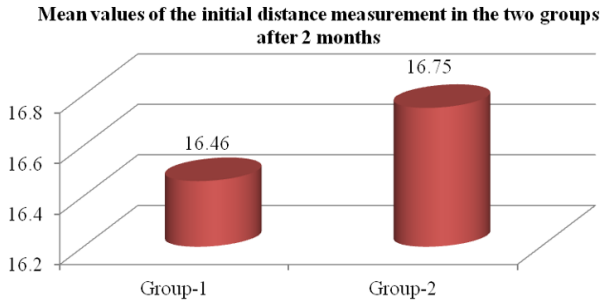
The entire data was entered and cleaned in MS-Excel before it was subjected to statistical analysis. All the results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly. The entire data was statistically analyzed using Statistical Package for Social Sciences (SPSS version 21.0, IBM Corporation, USA) for MS Windows.

3. Results

The total sample size in the present study was 80 (40 bilateral participants). Table 1 shows the measurements on the cast model at baseline and after 2 months of the treatment of Group 1 and 2. The mean values of the distance measured initially was 19.977 (±1.63) in group 1 and it was 19. 854 (±2.19) in group 2 (Table 2). The mean values of the distance measured after 2 months was 16.469 (±1.719) in group 1 and it was 16.857 (±2.438) in group 2 (Table 2). In this study, we are interested whether there is significant difference between the difference in measurements on the cast model at baseline and after 2 months of the treatment of Group 1 and 2. Unpaired t-test was performed and we observed that the mean difference of the cast model in group 1 was significantly greater than that of group 2 (p= 0.028) (Table 3). Table 04 shows the interleukin 1β levels at baseline and after 2 months of the treatment of Group 1 and 2. The Table 5 shows the mean and standard deviation of the 2 groups for the interleukin 1 β levels at baseline and after 2 months. The mean values of interleukin 1 β levels initially was 289.4 (±9.4) in group 1 and it was 290.3 (±9.4) in group 2 (Table 5). The mean values of interleukin 1β levels after 2 months was 354.5 (±14.33) in group 1 and it was 323.9 (±9.6) in group 2 (Table 5). Also, we are interested whether there is significant difference between the difference in interleukin 1 β levels at baseline and after 2 months of the treatment of Group 1 and 2. The results showed at 95% Confidence Interval for the difference between the 2 groups was between 25.43 and 37.72. Unpaired t-test was performed and we observed that the mean difference of the interleukin 1 β levels in group 1 was significantly greater than that of group 2 (p= 0.00) (Table 6).



Graph 1: Mean values of the initial distance measurement in the two groups at baseline.



Graph 2: Mean values of the initial distance measurement in the two groups after 2 months.

4. Summary of Results

The study involved 80 sites in 40 patients. No difference in the mean values of the initial distance between the canine and the molar was observed before the start of the retraction. After 2 months, the laser group showed a significant greater reduction in the canine to molar distance than the site treated with conventional technique. The interleukin 1 β levels raised significantly for the site treated with laser as compared to the other.

Overall we observed that:

1. Increased inflammatory response in the form of raised interleukin levels

Table 1: Individual measurements of the distance between the tip of the canine and the tip of the mesiobuccal cusp at baseline and after 2 months in both the groups.

S.No.	Group 1		Group 2	
	At baseline	After 2 months	At baseline	After 2 months
1.	19.363	14.72	19.436	17.256
2.	20.716	15.016	21.337	18.589
3.	17.451	15.467	18.14	16.835
4.	19.16	16.673	18.72	17.037
5.	19.538	16.513	19.547	15.922
6.	21.653	18.797	22.829	20.585
7.	20.61	16.372	20.435	15.202
8.	22.084	20.063	24.782	23.148
9.	16.537	13.027	17.247	14.912
10.	21.611	17.31	16.647	14.578
11.	19.284	15.895	18.105	15.561
12.	19.538	16.513	16.547	14.745
13.	21.611	17.31	20.67	14.784
14.	19.363	14.72	19.436	15.249
15.	20.716	15.016	21.337	18.589
16.	17.451	15.467	18.14	16.835
17.	19.16	16.673	18.72	16.562
18.	19.538	16.513	20.647	17.014
19.	21.653	18.797	22.829	20.585
20.	20.61	16.372	20.16	16.562
21.	22.084	20.063	24.782	23.148
22.	16.537	13.027	17.247	14.912
23.	21.611	17.31	16.647	14.784
24.	19.284	15.895	18.105	15.561
25.	19.538	16.513	18.538	15.922
26.	21.611	17.31	20.647	16.874
27.	19.363	14.72	19.436	15.249
28.	20.716	15.016	21.337	18.589
29.	17.451	15.467	19.41	16.835
30.	19.16	16.673	18.72	16.254
31.	19.538	16.513	20.897	15.922
32.	21.653	18.797	22.829	20.585
33.	20.61	16.372	18.35	15.202
34.	22.084	20.063	24.782	23.148
35.	16.537	13.027	17.247	14.912
36.	21.611	17.31	20.647	14.784
37.	19.284	15.895	18.105	15.561
38.	19.538	16.513	19.458	15.922
39.	21.611	17.31	20.64	14.784
40.	21.611	17.31	20.64	14.784

Table 2: Mean and standard deviation of the distance between the tip of the canine and the tip of the mesiobuccal cusp at baseline and the end of 2 months in both the groups.

	Group 1		Group 2	
	Baseline	After 2 months	Baseline	After 2 months
Mean	19.977	16.459	19.854	16.857
Standard Deviation	1.63	1.72	2.19	2.44

Table 3: Comparison between the difference in measurements on the cast model at baseline and after 2 months of the treatment of two groups.

Result	t statistics	Degree of freedom	p-value	Mean Difference
Equal variance	1.938	78	0.028	0.521
		F statistics	Degree of freedom (numerator, denominator)	p-value
Test for equality of variance		0.634	39,39	0.09

Table 4: Distribution of the interleukin 1 beta levels at baseline and after 2 months in both the groups.

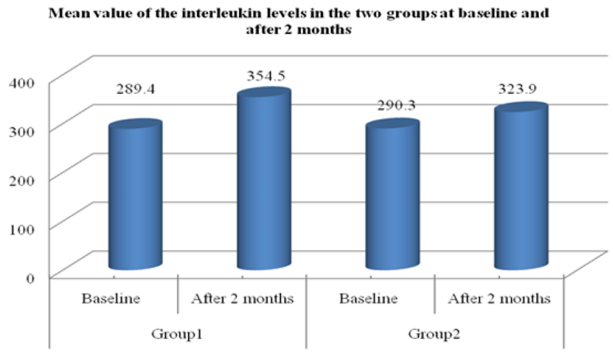
Serial number	Group 1		Group 2	
	At baseline	After 2 months	At baseline	After 2 months
1.	294	357	290	324
2.	294	360	289	320
3.	293	347	267	322
4.	295	345	289	334
5.	280	356	291	330
6.	287	344	292	321
7.	267	357	297	312
8.	289	349	300	311
9.	290	369	280	314
10.	294	345	287	316
11.	294	359	267	318
12.	294	379	289	330
13.	295	356	290	350
14.	280	354	294	340
15.	287	357	300	311
16.	267	342	311	322
17.	289	324	299	321
18.	290	341	293	334
19.	294	356	293	354
20.	294	349	280	335
21.	295	344	287	320
22.	287	357	267	321
23.	294	349	289	320
24.	290	369	290	312
25.	289	356	294	311
26.	267	341	294	315
27.	289	379	294	321
28.	291	356	293	324
29.	292	354	293	320
30.	297	357	300	330
31.	300	342	301	321
32.	280	324	300	324
33.	287	341	300	323
34.	267	353	293	334
35.	289	350	293	321
36.	290	352	293	320
37.	294	357	295	324
38.	300	399	280	324
39.	311	376	279	325
40.	299	378	280	326

Table 5: Mean and standard deviation of interleukin levels baseline and at the end of 2 months in both the groups.

	Group 1		Group 2	
	Baseline	After 2 months	Baseline	After 2 months
Mean	289.4	354.5	290.3	323.9
Standard Deviation	9.4	14.33	9.4	9.6

Table 6: Comparison between the difference in measurements of interleukin 1 beta levels at baseline and after 2 months of the treatment of two groups.

Result	t statistics	Degree of freedom	p-value	Mean Difference
Equal variance	10.2359	78	0.00	31.575
		F statistics	Degree of freedom (numerator, denominator)	p-value
Test for equality of variance		1.06	39,39	0.428



Graph 3: Mean values of the interleukin levels in the two groups at baseline and after 2 months

2. Faster distalization of the canine when adjunct with low level soft tissue laser

5. Discussion

The major issue with orthodontic treatment is the time involved. More the time, more the follow ups and patient compliance is compromised at times with such a long duration. At times, reinforcing the post treatment measures is also a challenge for the orthodontist. The average active treatment time of two years approximately tests the patience of the patient to a great extent. Hence to attain faster results, it is imperative that bone remodelling occurs at a faster speed and with more consistency to prevent the problem of relapse. The entire treatment time is dictated by the complexity of the condition and the type of treatment plan meted out by the orthodontist. Faster and effective aesthetic results are the needs of the hour. A vigorous attempt to design and execute various forms of accelerated teeth movements is currently on the rise since many decades. Some of these include the use of magnets; current therapies such as photobiomodulation, accelerated orthodontics, chemicals, distraction osteogenesis are among the others. With none of these proving to be highly effective, evidence is being sought to help understand the best, option or if any; a totally different option if available. Light emitting diodes, which came into existence in 1980s when applied to the gingival tissues, seem to activate the PDL cells and the surrounding osteoblasts. This localized effect helps to concentrate only on areas that need to be treated.[2] At times, corticotomies has proven to improve the orthodontic movements by increased stimulation; but with a disadvantage that they can be performed only along the areas with cortical portions of the alveolar bone. Also there is lesser patient compliance due to the surgical procedure involved merely for an accelerated tooth movement. Distraction osteogenesis involve intervention by use of burs along the canines and these holes created around the roots are used further for canine retraction. This has been a proven technique that is not only successful in terms of patient acceptance but also with time. It reduced the time of treatment by a great extent. Low level laser therapy is now the answer to the issue of non-surgical and bloodless intervention with quicker results. This has been directed more towards soft tissues and has a greater potential to provide an impetus to better results compared to the rest. This therapy has been documented extensively in literature. It is an effective method to ensure bone regeneration and modulation to assist in the tooth movements; that is the biggest challenge in clinical practise. Initial experiment was performed on the midpalatal suture regions to bring about the accelerated palatal expansion by means of collagen synthesis. Shimizu et al reported their experiment outcomes on rats. They observed that with LLLT, there was increased vascularization that could serve as an essential factor in tissue repair. An overall effect of more than 30% was observed in these rats with respect to tooth movements.[9] Nonetheless, sparse data is available with respect to human comparative studies, especially in terms of clinical evidence of the same therapy among the Indian population. Certainty of the same with respect to local set up has not been successfully established and is an important gap in the existing literature that we tried to address in the present study. For the present study, only adult patients were chosen as participants and those with any medical history, on anti-inflammatory drugs and with previous orthodontic treatments were excluded to avoid any impending bias with the study results. We used Stainless steel wire (Captain Ortho SS wire) of 0.018 inch diameter which was placed in the arch and retraction was initiated. It is known that teeth movement can be influenced by the type of material and diameter of orthodontic archwire especially during sliding mechanics. It is known that stiffer wires can better resist the tendency of teeth tilting during sliding. Moreover, friction increases as bracket slots are filled. For these reasons, a round, 0.018-inch SS arch wire was selected. The canine bracket was

secured tightly with stainless steel ligatures as elastomeric modules tend to lose its elasticity and cause rotation during retraction. The Ezlase 940 (Biolase) diode laser was used to irradiate the canines prior to retraction. According to the International Electrotecnical Commission (IEC) 60825 – 1 standard this laser was classified as class 4 lasers. It had a standardized wavelength of 940 nm, with an output power of 100 mW, and an exposure time of 15 seconds per spot (mesio-cervical, disto-cervical, middle, mesio-apical, disto-apical areas of the canine root). The 940 nm wavelength works efficiently at low power. The low power was well absorbed by hemoglobin and oxyhemoglobin. Hence reduced amount of heat was produced. Laser emitted at the particular wavelength penetrates the tissue depths with ease. Different substance matter preferentially absorbs light at varying wavelengths. Laser photons that travel through a given material with a high absorption coefficient for its specific wavelength will lose energy through absorption more readily than a material with a lower coefficient for that material. Because these photons are readily absorbed, this light travels much shorter distances than those light wavelengths that are not absorbed. The absorption of photons from a laser's initial ray effectually degrades the power of light with distance travelled. It has been reported that only a fraction of the photons are actively able to reach the desired depth and bring about the required effect.[10] The extent of penetration and the number of photons reaching the desired site was beyond the scope of the present study outcomes. We did a laser irradiation for 3,7,14 and then every 15 days for 2 months of the treatment period in the participants.[7] Five areas were irradiated on the periodontal ligament of the canines for 15 seconds according to the previous published literature.[8] This method helped us cover all the PDL fibres and the alveolar bone around the canine. The wavelength used was 940 nm and this allowed for a penetration of light upto a depth of 0.0001 mm. This also ensured that the exposure of the light was negligible and would not result in any carcinogenic results to the patient at a later stage and also help us avoid unnecessary stimulation and excessive bone and surrounding tissue damage. Nickel titanium closed coil springs were used for retraction of the canines on both laser and non-laser sides. These springs provide a force level that could be maintained for a longer period of time. Nickel-titanium closed coil springs produce a more consistent force when compared with elastomeric chains as a method of force delivery to close extraction space along a continuous arch wire.[11] The force selected for retraction of canines was 150 gms which was measured using a Dontrix gauge (Ormco, Italy).We ensured that light forces were applied to induce better movements, less damage to the tissues and also to reduce pain to the patient. Literature suggests use of lighter forces and also use of intermittent forces if needed rather than greater implied forces for a better result and lesser tissue damage. The retraction spring was reactivated on day 21 for all sides.[11] We prepared study model casts before and at the end of retraction for a better understanding and measurement was made using a digital Vernier calliper for assessing canine retraction. The measurements were compared with two experts to avoid observational bias although there are computer software options available for the same. This use of physical measurement is one of the limitations of our study. The softwares usually are based on the diagnostic casts prepared for scanning images and they are superimposed upon each other to see the amount of difference in the teeth positioning post treatment. Study in the West reports that measurement by calliper is equally effective in reaching a conclusion.[4] In the present study the mean values of the distance measured after 2 months was 16.469 (±1.8) in group 1 and it was 16.857 (±2.5) in group 2. When unpaired t-test was performed, we observed that the mean measurement in group 1 was significantly greater than that of group 2 (p= 0.028) (Table 03). This was similar to the studies reported previously in literature.[8] A 2004 study showed that the irradiated canines were retracted at a rate 34% greater than the control canines over 60 days. The author reported that LLLT significantly accelerates orthodontic movement in humans with a healthy response from periodontal tissues. Therefore it can be considered in order to shorten the treatment duration.[8] The mechanisms of LLLT rely on the red and near‑infrared wavelengths in the electron transport chain in the mitochondria of the cells. The light absorption causes an activation of respiratory chain and oxidation of the NADH pool. The electron transport chain promotes cell changes by increasing ATP supply, and increased electrical potential of the mitochondria membrane, alkalization of the cytoplasm, and activation of nucleic acid synthesis. Mast cells are triggered ultimately. It has been proved that 660, 820, and 940 nm light triggers mast cell degranulation and release TNF. TNFα promotes leukocyte infiltration of tissues.[11–17]

LLLT also stimulates differentiation to myofibroblasts and accelerates wound healing. LLLT given for a short duration can significantly promote proliferation and promote differentiation of human osteoblasts in vitro as compared to non - irradiated cells. Osteoblasts proliferate and differentiate at a higher rate at the site of injury and accelerate the rate of calcium accumulation and bone repair. Abi-Ramia et al stated that LLLT showed reversible hyperaemia with orthodontic tooth movement and faster repair due to an increased pulpal response.[6] Limpanichkul et al reported a clinical trial showing no appreciable effect on LLLT over 4 months in a split mouth study design. This was in complete contrast to the findings of the present study. They concluded that possibly the energy density produced by the laser was way too low and had no effect on the orthodontic tooth movement.[12] Another

study reported that there was no statistical difference in the rate of canine movement or canine angulation between laser and conventional technique. In fact when the authors assessed pain via the VAS pain score participants on the laser side were more sensitive than that on the conventional side. Another study conducted in 2014 study used 810 nm galliumaluminium-arsenide (Ga-Al-As) laser, which showed no effect on velocity of canine retraction and on pain perception in adults.[7] A study on rabbits cautions the use of LLLT because even though the movements are accelerated, the chances of relapse are significantly higher with the same as compared to that of the conventional therapy.[55] In the present study we observed increased levels of interleukin in GCF at the laser site compared to the controls. The GCF collection was on the distal aspect of the canine as per previous published literature. A 2006 study reported that an increased level coincided with a raised biologic activity with the periodontal tissue during orthodontic tooth movement.[62] The mean values of interleukin 1 beta levels initially was 289.4 (±9.4) in group 1 and it was 290.3 (±9.4) in group 2 (Table 05). The mean values of the interleukin 1 beta levels after 2 months was 354.5 (±14.33) in group 1 and it was 323.9 (±9.6) in group 2 (Table 05). Our findings were similar to that by Bicacki et al and Yassaei where an increase in mediators of inflammation was seen. Another study with use of aligners reported that bone modulators were raised significantly with laser application. A 2016 study in Turkey reported a significant raise in Interleukin levels with application of gallium-aluminium-arsenide diode laser of 20mW. The authors argue that IL-1β levels increase on the compression side is indication of osteoblastic activity while L-1β levels on compression side indicated raised osteoclastic activity during canine retraction. Altan et alreported that even though the biomarkers of inflammation were higher on the laser side it need not reflect always as an accelerated tooth movement. Hence with such contrasting findings, more robust measures are needed to evaluate the biological prospects of LLLT on canine retraction.

6. Conclusion

We observed that there was a clinically appreciable amount of retraction seen resulting in faster space closure between the canine and the first permanent molar in the group that had low level laser than the other group that was treated by the conventional therapy. We also observed a considerable rise in the interleukin 1β levels in the laser group. This shows that faster tooth movement can be easily achieved with good appreciable results by adding low level laser treatment as a part of the plan for orthodontic patients. Also a need to appreciate the pertinent role that lasers can play in successful yet faster treatment modalities should be explored especially in this field that needs a long term association with the patient for achieving an aesthetic and functional smile.

7. Conflict of Interest

The authors declare that they have no conflict of interest.

8. Source of Funding

None.

9. Ethical Approval

Study is approved by ethical committee of institute and MUHS research committee.

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References

1. Usui T, Iwata T, Miyake S. Mechanical and frictional properties of aesthetic orthodontic wires obtained by hard chrome carbide plating. *J Dent Sci*. 2018;13(2):151–59. doi:10.1016/j.jds.2017.07.003.
2. Jung O, Becker JP, Smeets R. Surface Characteristics of Esthetic Nickel-Titanium and Beta-Titanium Orthodontic Archwires Produced by Plasma Electrolytic Oxidation (PEO)-Primary Results. *Materials (Basel)*. 2019;12(9):1403. doi:10.3390/ma12091403.
3. Francisconi MF, Janson G, Henriques JFC, Freitas KMS, Francisconi PAS. Evaluation of the force generated by gradual deflection of 0.016-inch NiTi and stainless steel orthodontic wires in self-ligating metallic and esthetic brackets. *J Clin Exp Dent*. 2019;11(5):464–9. doi:10.4317/jced.55698.
4. Matias M, Freitas MR, Freitas K. Comparison of deflection forces of esthetic archwires combined with ceramic brackets. *J Appl Oral Sci*. 2018;26:e20170220. doi:10.1590/1678-7757-2017-0220.
5. Alsanea JA, Shehri A, H. Evaluation of Nanomechanical Properties, Surface Roughness, and Color Stability of Esthetic Nickel-Titanium Orthodontic Archwires. *J Int Soc Prev Community Dent*. 2019;9(1):33–9.
6. Collier S, Pandis N, Johal A. A prospective cohort study assessing the appearance of retrieved aesthetic orthodontic archwires. *Orthod Craniofac Res*. 2018;21(1):27–32. doi:10.1111/ocr.12207.
7. Tikku T, Khanna R, Agarwal A, Srivastava K, Shekhar S, Shukla I, et al. Load-deflection characteristics of coated and noncoated nickel-titanium wires in self-ligating brackets using a modified bending test: An in vitro study. *Dent Res J (Isfahan)*. 2019;16(1):1–6.
8. Pinzan-Vercelino CRM, Gurgel JDA, Bramante FS, Pessoa TF, Albertin SA, Fialho MPN, et al. Coated nickel titanium archwires and their uncoated counterparts: In-vitro contemporary comparison of unloading forces. *Int Orthod*. 2020;18(2):374–9. doi:10.1016/j.ortho.2020.01.007.
9. Shirakawa N, Iwata T, Miyake S. Mechanical properties of orthodontic wires covered with a polyether ether ketone tube. *Angle Orthod*. 2018;88(4):442–9. doi:10.2319/082417-572.1.
10. Silva DD, Mattos CT, Simão RA, Ruellas ADO. Coating stability and surface characteristics of esthetic orthodontic coated archwires. *Angle Orthod*. 2013;83(6):994–1001. doi:10.2319/111112-866.1.
11. Muguruma T, Iijima M, Yuasa T, Kawaguchi K, Mizoguchi I. Characterization of the coatings covering esthetic orthodontic archwires and their influence on the bending and frictional properties. *Angle Orthod*. 2016;87(4):610–17. doi:10.2319/022416-161.1.

12. Lin CY, Kim JS, Lin ET, Lin ET. Prolonged water immersion alters resistance to sliding of aesthetic orthodontic coated wires. *Orthod Craniofac Res*. 2020;24(1):111–20. doi:10.1111/ocr.12413.
13. Elsaka S, Hassan A, Elnaghy A. Effect of gastric acids on surface topography and bending properties of esthetic coated nickel-titanium orthodontic archwires. *Clin Oral Investig*. 2020;25(3):1319–26. doi:10.1007/s00784-020-03438-7.
14. Shamohammadi M, Hormozi E, Moradinezhad M, Moradi M, Skini M, Rakhshan V, et al. Surface topography of plain nickel-titanium (NiTi), as-received aesthetic (coated) NiTi, and aesthetic NiTi archwires sterilized by autoclaving or glutaraldehyde immersion: A profilometry/SEM/AFM study. *Int Orthod*. 2019;17(1):60–72. doi:10.1016/j.ortho.2019.01.016.
15. Garro-Piña H, Mc JC, Ondarza-Rovira R, Justus R, García-López S. Evaluation of the Loading, Unloading, and Permanent Deformation of Newly Available Epoxy Resin Coated Ni-Ti Wires Using Self-Ligating Brackets. *Int J Dent*. 2017;p. 5463142–5463142.
16. Francisconi MF, Janson G, Henriques JF, Freitas KM. Evaluation of the force generated by gradual deflection of orthodontic wires in conventional metallic, esthetic, and self-ligating brackets. *J Appl Oral Sci*. 2016;24(5):496–502.
17. Kim Y, Cha JY, Hwang CJ, Yu HS, Tahk SG. Comparison of frictional forces between aesthetic orthodontic coated wires and self-ligation brackets. *Korean J Orthod*. 2014;44(4):157–67.

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