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ORIGINAL RESEARCH

COMPARATIVE EVALUATION OF LOW LEVEL LASER AND INJECTABLE PLATELET RICH FIBRIN ON THE RATE OF CANINE RETRACTION.

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ABSTRACT

Objective: To compare the effect of LLLT and I-PRF on the rate of maxillary canine retraction following first premolar extraction.

Methods: A clinical study was conducted on 28 female patients divided into two equal groups. In Group 1 (n=14), LLLT was applied to the right maxillary canine, while the left served as a control. In Group 2 (n=14), I-PRF was injected around the right maxillary canine, with the left side as control. Canine retraction was measured monthly over four months using casts that were fabricated and then scanned with a 3D scanner

Results: Group 1, the LLL side (right), showed a statistically significant higher rate of canine retraction than the control side (left); group 2, I-PRF, showed a statistically significant higher rate of canine retraction over the control side (left). LLLT resulted in a significantly higher rate of movement over the four-month observation period.

Conclusion: In both groups the experimental side showed accelerated canine movement compared to the control side, the LLL yielded higher rate of canine movement when compared to I-PRF.

***Keywords*:** Acceleration, Laser, I-PRF

1. INTRODUCTION

Orthodontic treatment often spans several months to years, presenting a challenge for both patients and clinicians in terms of compliance, treatment-related discomfort, and potential risks such as root resorption and enamel demineralization.[1] As a result, accelerating orthodontic tooth movement (OTM) has become a major area of research, with the goal of reducing treatment duration while maintaining biological safety and treatment efficacy[2].

Various methods have been proposed to enhance OTM, including surgical approaches (e.g., corticotomies)[3], mechanical vibration[4], pharmacological agents, and biostimulation techniques.[5,6]

LLLT is a non-thermal photobiomodulation therapy that has been shown to stimulate cellular activity, increase vascularization, and enhance the expression of cytokines and growth factors involved in bone remodeling.[7] Several clinical studies have reported a significant increase in the rate of tooth movement with the application of LLLT, making it a promising adjunct in orthodontics.[8,9]

Injectable platelet-rich fibrin (I-PRF), a second-generation platelet concentrate, is rich in autologous growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF).[10] These biomolecules play key roles in inflammation regulation and tissue regeneration.

When injected into periodontal tissues, I-PRF has the potential to enhance bone remodeling and accelerate tooth movement through biological stimulation.[11] I-PRF has

many advantages over the other platelets concentrates, it does not contain anticoagulants, and releases seven times more growth factors gradually and sustainably than PRP.[12]

There are still few comparative studies comparing the effects of LLLT and I-PRF on orthodontic tooth movement, despite their distinct advantages. Clinicians can choose the most beneficial adjunctive technique for a given instance by being aware of the variations in their efficacy.

Therefore, the aim of this study was to compare the effects of low-level laser therapy and injectable platelet-rich fibrin on the rate of maxillary canine retraction following first premolar extraction.

2.MATERIALS AND METHODS

Study Design and Ethical Approval

This randomized, controlled clinical study was conducted on 28 female patients requiring bilateral maxillary canine retraction following first premolar extraction as part of their comprehensive orthodontic treatment. The study was approved by the Research Ethics Committee of the faculty of Dental Medicine for girls, Al-Azhar university code (REC-OR-25-04), in Cairo. Informed consent was obtained from all participants.

Sample Size and Group Allocation

The Sample size was estimated assuming 5% alpha error and 80% power, and effect size(d) 0.991 based on the results of pervious study.[13] The estimated sample size was found to be 14 per each group. The participants were divided into two equal groups (n=14 each) using randmizer.org website: Group 1 (LLLT Group): Received low-level laser therapy (LLLT) on the right maxillary canine; the left side served as the control. Group 2 (I-PRF Group): Received injectable platelet-rich fibrin (I-PRF) around the right maxillary canine; the left side served as the control. Blinding either the patient or the operator was not possible, blinding was done at the measurement stage, the measurers were blinded to the control and intervention sides.

All patients were treated with a fixed appliance system 0.022 inch slot Roth prescription (Vector Plus, Brazil). After initial alignment and leveling, a 0.019 × 0.025-inch stainless steel arch wire was inserted for retraction using a sliding mechanism.

Canine Retraction Protocol

Retraction was initiated using nickel-titanium closed coil springs delivering 150 g of force bilaterally.

Low-Level Laser Therapy Protocol (Group 1)

A diode laser with a wavelength of 940 nm, power output of 0.2 mW, and energy density of 3.13 J/cm² was used. LLLT was applied on days 1, 14, 28, and 56 on the buccal and palatal sides of the right canine root area at five points (mesiobuccal and distobuccal at the gingival crest, distal, mid-root, mesiobuccal and distobuccal at the root apex) for 2 seconds per point. The same spots were chosen for the palatal surface. (fig.1)

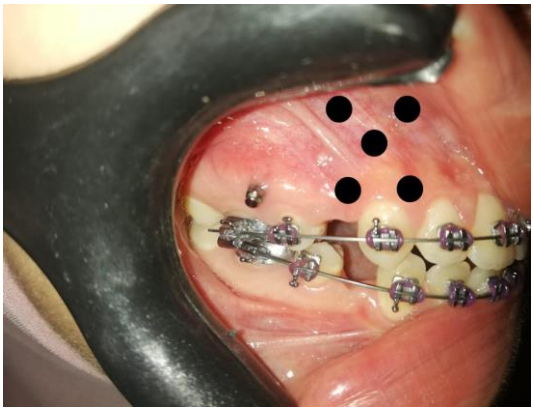

Figure 1. Marked sites for LLL application on the labial surface of the canine region. The five black dots represent: distobuccal gingival crest, mesiobuccal gingival crest, central mid-root point, mesioapical and distoapical points

Injectable Platelet-Rich Fibrin Protocol (Group 2)

I-PRF was prepared by centrifuging 10 mL of venous blood at 700 rpm for 3 minutes using a horizontal centrifuge. The supernatant was collected and injected submucosally around the right canine at the onset of canine retraction and after one month. (fig.2)

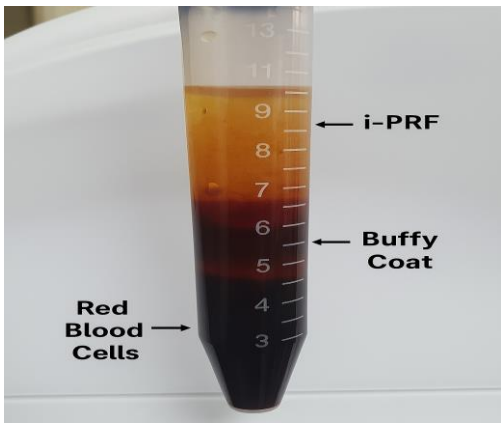

Figure 2. Centrifuged blood sample showing distinct separation into three layers: the upper (I-PRF) layer, a thin buffy coat containing leukocytes and platelets, and the lower red blood cell layer.

Measurement of Canine Retraction

For each case, the upper dental casts were superimposed using the pre-retraction model as the reference and each post-retraction scan as the test, employing 3-matic14.0 software (Materialise N.V., Belgium). A vertical midline plane was constructed based on the incisive papilla and the median palatine raphe. A horizontal plane was then defined as a tangent to the most posterior convex point distal to the second molar. These vertical and horizontal planes were set to

be perpendicular to each other.
From the tip of each canine (right and left), a perpendicular line was drawn to the vertical midline plane, creating two distinct points. These points represented the anteroposterior positions of the canines. The linear distances between each of these points and the horizontal plane were measured using the aforementioned software, enabling the assessment of canine retraction.

Statistical analysis:

Statistical analysis was conducted using a commercially available software program (SPSS version 20, IBM Corp., Armonk, NY, USA). Numerical data were summarized as mean ± standard deviation (SD), 95% confidence intervals (CIs), and range. Normality of the data distribution was assessed using both the Kolmogorov-Smirnov and Shapiro-Wilk tests.
Given that the data were normally distributed, intergroup comparisons and comparisons between the right and left sides within the same group were performed using the independent samples t-test. Repeated measures ANOVA and paired samples t-test were employed to evaluate intra-group differences across different time intervals. All statistical tests were two-sided, and a p-value ≤ 0.05 was considered statistically significant.

3.RESULTS

The study included 28 female patients, with 14 in each group. The mean age in the I-PRF group was 22.93 ± 1.90 years, while the LLLT group had a mean age of 21.29 ± 2.52 years. The difference between the two groups was not statistically significant (p = 0.063).
Comparison Between Groups: (Table.1)
Right Side (Experimental): LLLT showed significantly higher rates of canine retraction than I-PRF in all intervals from T0 to T4 (p < 0.05). The total canine retraction over 4 months (T0–T4) was significantly higher in the LLLT group (3.15 ± 0.25 mm) than the I-PRF group (2.56 ± 0.13 mm),(p = 0.000).
Left Side (Control): No statistically significant difference in the total rate of canine retraction over 4month (T0-T1) was found between the LLLT group (2.56±0.36) and I-PRF group (2.56±0.36) on the control (left) side, (p=0.134).
Intra-Group Comparison (Right vs. Left Sides)
I-PRF Group:
The total canine retraction over 4 months (T0–T4) was significantly higher in the Right side (I-PRF) (2.56±0.13 mm) than the left side (control) (2.4 ± 0.11 mm), (p = 0.000).

LLLT Group:
The total canine retraction over 4 months (T0–T4) was significantly higher in the Right side (LLL) (3.15±0.25 mm) than the left side (control)(2.56 ± 0.36 mm),(p = 0.000).(fig.3).

Table 1. Descriptive statistics and results of independent t test for comparison between rates of canine retraction in right and left sides of each group

Groups			Mean	Std. Deviation	t	P value
iPRF	T0_T1	.Right	.66	.06	-1.71	.111 ns
		Left	.67	.06		
	T1_T2	.Right	.74	.07	19.87	.000*
		Left	.58	.05		
	T2_T3	.Right	.63	.05	-.354	.729 ns
		Left	.63	.04		
	T3_T4	.Right	.52	.04	-.159	.876 ns
		Left	.52	.04		
	T0_T4	**.Right**	**2.56**	**.13**	**17.5**	**.000***
		Left	**2.40**	**.11**		
LLLT	T0_T1	.Right	.85	.07	6.37	.000*
		Left	.71	.09		
	T1_T2	.Right	.82	.07	6.18	.000*
		Left	.68	.09		
	T2_T3	.Right	.77	.06	5.95	.000*
		Left	.64	.08		
	T3_T4	.Right	.71	.05	6.19	.000*
		Left	.53	.11		
	T0_T4	**.Right**	**3.15**	**.25**	**6.23**	**.000***
		Left	**2.56**	**.36**		

Significance level p≤0.05, *=significant, ns=non-significant

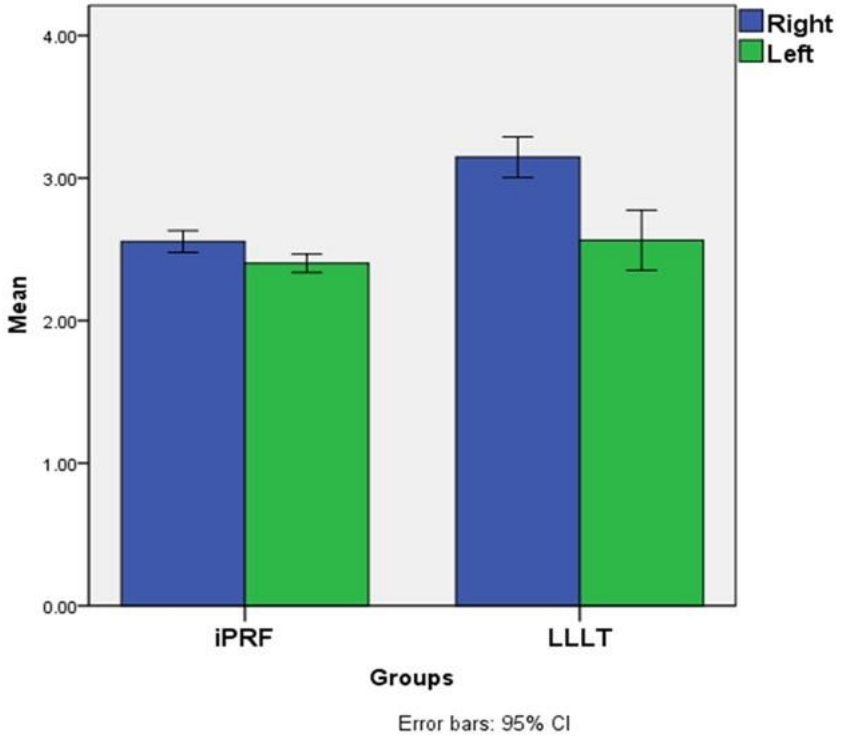

Figure 3. Bar chart illustrating mean rate of canine retraction from T0 to T4 in both groups

4.DISCUSSION

The present study aimed to evaluate and compare the effectiveness of low-level laser therapy (LLLT) and injectable platelet-rich fibrin (I-PRF) on the rate of maxillary canine retraction. Both modalities have been explored in the literature as non-invasive techniques to accelerate orthodontic tooth movement through enhancement of bone remodeling.

In Group 1, which received LLLT, the right side (laser-treated) showed a statistically significant increase in the rate of canine movement compared to the untreated left side during all observation periods. These findings are in agreement with previous studies that reported a stimulatory effect of LLLT on osteoclastic and osteoblastic activity, leading to accelerated bone turnover and faster tooth movement, also LLLT is thought to enhance cellular ATP production and stimulate cytokine release, which in turn enhances the remodeling process essential for tooth movement.8,9

A systematic review conducted by Chintavalakorn et al.14 evaluated 25 clinical studies investigating the effect of low-level laser therapy (LLLT) on the acceleration of orthodontic tooth movement. Their analysis revealed that 21 of the included studies demonstrated a significant positive effect of LLLT on the rate of tooth movement, supporting its efficacy as an adjunctive tool in orthodontics.

Similarly, Fini et al.15 reported consistent findings in their review, highlighting that the majority of the evaluated studies documented a statistically significant acceleration in tooth movement associated with the use of LLLT.

In Group 2, which received I-PRF, a statistically significant increase in the rate of canine movement was observed only during the second month of retraction. This transient effect may be attributed to the initial burst release of growth factors from i-PRF, including PDGF, TGF-β, and VEGF, which promote angiogenesis and osteogenesis.12

However, as the growth factors are consumed or degraded over time, the stimulatory effect diminishes. This partial effect is consistent with other clinical studies that found I-PRF to be effective primarily in the early phase of retraction.16,17

This was in accordance with Zeitounlouian et al.17 as the I-PRF and PRP do not crucially affect the rate of tooth movement. Even in those studies demonstrating a statistically significant acceleration, also sequential injections might be necessary on a monthly basis to reach a sustained faster movement.

When comparing both modalities, LLLT demonstrated a more consistent and prolonged enhancement of tooth movement across all time

Intervals, whereas I-PRF's effect appeared limited to the short term. This could suggest that while both methods support accelerated movement, LLLT may provide a more sustained modulation of the bone remodeling process

5.CONCLUSION

Both low-level laser therapy and injectable platelet-rich fibrin were effective in accelerating maxillary canine retraction compared to control sides. However, LLLT resulted in a significantly higher rate of movement over the four-month observation period, while the effect of I-PRF was significant only during the second month. These findings suggest that LLLT may offer a more predictable and sustained approach for enhancing orthodontic tooth movement.

6.DECLARATIONS

FUNDING

No external funding was received for this study.

ETHICAL APPROVAL

This randomized, controlled clinical study was conducted on 28 female patients requiring bilateral maxillary canine retraction following first premolar extraction as part of their comprehensive orthodontic treatment. The study was approved by the Research Ethics Committee of the faculty of Dental Medicine for girls, Al-Azhar university code (REC-OR-25-04), in Cairo. Informed consent was obtained from all participants.

INFORMED CONSENT

Written informed consent was obtained from all participants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Ahmad M, Taha K. Acceleration of Orthodontic Tooth Movement Overview. In: Orthodontics - Current Principles and Techniques. IntechOpen; 2024. DOI: 10.5772/intechopen.113384

[2] Nasef A, Ibrahim S, El Kabbany S. Assessment of Rate of Orthodontic Tooth Movement with Different Modalities of Ligations. Azhar J Dent. 2022;9:19. DOI: Not available

[3] Hasaneen B, Ibrahim S, El-Kilani N, Mohamed M. Assessment of Accelerating Orthodontic Tooth Movement by Hard Laser Corticotomy. Azhar J Dent. 2022;9:17. DOI: Not available

[4] Shipley T, Farouk K, El-Bialy T. Effect of high-frequency vibration on orthodontic tooth movement and bone density. J Orthod Sci. 2019;8:15. DOI: 10.4103/jos.JOS_119_18

[5] Nadkerny V, Singh G, Chhaya B, Dubey R, Kesharwani S, Singh A, Singh Makkad R. A review on accelerated orthodontics. Bioinformation. 2023;19:126-32. DOI: 10.6026/97320630019126

[6] Ciobotaru C, Feștilă D, Dinte E, Muntean A, Bosca B, Ionel A, Ilea A. Enhancement of Orthodontic Tooth Movement by Local Administration of Biofunctional Molecules: A Comprehensive Systematic Review. Pharmaceuticals. 2024;16:984. DOI: 10.3390/ph16100984

[7] Attia M, Hazzaa H, Al-Aziz F, Elewa G. Evaluation of adjunctive use of low-level diode laser biostimulation with combined orthodontic regenerative therapy. J Int Acad Periodontol. 2019;21:63-73.

[8] Alam M, Hajeer M, Alanazi D, Alanazi S, Alruwaili H. The Effect of Low-Level Laser Therapy on Accelerating Tooth Movement in Orthodontic Patients: A Randomized Controlled Trial. J Pharm Bioall Sci. 2024;16:3658-60. DOI: 10.4103/jpbs.jpbs_370_23

[9] Parekh U, Shetti S, Agrawal J, Agrawal M, Fulari S, Golgire S. Efficacy of low-level laser therapy enhances the rate of canine retraction by increasing β glucoronidase and pentraxin–3 in gingival crevicular fluid:A clinicalstudy.JContempOrthod.2024;8:307-13.

[10] Naji R, Zeitounlouian T, Alomari E, Youssef M. Evaluation of the Efficacy of Platelet-Rich Plasma (PRP) and Injectable Platelet-Rich Fibrin (i-PRF) in the Acceleration of Canine Retraction: A Randomized Controlled Trial. J Int Oral Health. 2022;14:243-53. DOI: 10.4103/jioh.jioh_129_22

[11] Ibrahim A, Ibrahim S, Hassan S, Abd el-Samad F, Attia M. Assessment of Root Changes and Bone Density Accompanying Different Methods of Accelerated Orthodontic Tooth Movement. Azhar Dent J. 2020;7:5. DOI: Not available

[12] Paridhi A, Bhagyalakshmi B, Akila N. Evaluation of injectable platelet-rich fibrin effect on the rate of canine retraction and alkaline phosphatase levels: An in-vivo study. Am J Orthod Dentofacial Orthop. 2022;162:735-43. DOI: 10.1016/j.ajodo.2021.11.017

[13] Erdur E, Karakasli K, Oncu E, Ozturk B, Hakki S. Effect of injectable platelet-rich fibrin (i-PRF) on the rate of tooth movement. Angle Orthod. 2021;91:285-92. DOI: 10.2319/060920-524.1

[14] Chintavalakorn R, Saengfai N, Sipiyaruk K. The Protocol of Low-level Laser Therapy in Orthodontic Practice: A Scoping Review of Literature. J Int Soc Prev Community Dent. 2022;12:267. DOI: 10.4103/jispcd.JISPCD_599_21

[15] Fini M, Olyaee P, Homayouni A. The Effect of Low-Level Laser Therapy on the Acceleration of Orthodontic Tooth Movement. J Lasers Med Sci. 2020;11:204. DOI: 10.34172/jlms.2020.34

[16] Cagli K, Baka Z. Assessment of the effects of local platelet-rich fibrin injection and piezocision on orthodontic tooth movement during canine distalization. Am J Orthod Dentofacial Orthop. 2021;160:29–40. DOI: 10.1016/j.ajodo.2020.12.019

[17] Zeitounlouian T, Zeno K, Brad B, Haddad R. Effect of injectable platelet-rich fibrin (i-PRF) in accelerating orthodontic tooth movement: A randomized split-mouth-controlled trial. J Orofac Orthop.2021;82:268-77.DOI:10.1007/s00056-020-00267-5