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Original Research Article

Effectiveness of autologous leukocyte platelet-rich fibrin on orthodontic tooth movement: a split-mouth clinical study

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ABSTRACT

Background: Prolonged orthodontic treatment is associated with increased risk of enamel demineralization, root resorption, periodontal complications and reduced patient compliance. Leukocyte platelet-rich fibrin (L-PRF), an autologous platelet concentrate rich in growth factors and cytokines, has been proposed as a biological adjunct to accelerate orthodontic tooth movement. To evaluate the effectiveness of L-PRF in enhancing orthodontic canine retraction.

Methods: A split-mouth clinico-experimental study was conducted on nine patients aged 15–25 years requiring bilateral maxillary first premolar extractions. The right side received L-PRF placement in the extraction socket and served as the experimental side, while the left side acted as the control. Canine retraction was performed using nickel-titanium closed-coil springs delivering 150 g force. Tooth movement was assessed using three-dimensional digital models at baseline (T0), one month (T1), two months (T2) and three months (T3). Data were analyzed using paired t-test, repeated measures ANOVA and Bonferroni post-hoc analysis.

Results: Greater canine movement was observed on the L-PRF side throughout the study period. Statistically significant acceleration was noted during the initial phase of retraction, whereas differences during later intervals were not significant. Both groups demonstrated significant time-related variations in tooth movement.

Conclusions: L-PRF enhanced orthodontic tooth movement primarily during the early stages of canine retraction. It may serve as a safe, minimally invasive and biologically effective adjunct for accelerating orthodontic treatment and potentially reducing overall treatment duration.

Keywords: Orthodontic treatment, Leukocyte platelet-rich fibrin, Malocclusions

INTRODUCTION

Orthodontic treatment is very important because it helps correct malocclusions and improve dentofacial esthetics and functional occlusion. Although there have been many developments in the field of orthodontic appliances and biomechanics, the extended length of orthodontic treatment still remains a major problem. Traditional orthodontic treatment often lasts for several months up to several years and it increases the risk of enamel demineralization, gingival inflammation, root resorption and periodontal problems.[1] For this reason, there has been much research done on the development of biological treatment modalities which can accelerate orthodontic tooth movement.[2] With respect to orthodontic tooth movement, there is remodelling of periodontal ligaments and alveolar bones caused by mechanical loads. The remodelling results from the compression and tension generated in the periodontal ligament, which cause reactions such as cytokine, osteoclast and osteoblast activity, leading to bone resorption on one side and bone formation on the other side. However, the movement of

teeth varies between individuals and is quite slow. Various techniques have been explored to increase the rate of tooth movement, including surgical, mechanical, pharmacological and biological treatments. Surgical procedures include corticotomy, piezocision and micro-osteoperforations, among others, which work based on the regional acceleratory phenomenon to promote bone remodelling; however, the invasive aspect makes them less patient acceptable.[3,4] Mechanical techniques, such as low-level laser therapy and vibrational devices, have proven to be less effective in promoting tooth movement.

Autologous platelet concentrates are being considered biologically active materials for use as biological adjuncts owing to their ability to secrete growth factors for tissue and bone regeneration. Platelet rich fibrin (PRF), the second generation platelet concentrate, is obtained without the use of any anticoagulant and is composed of fibrin matrix containing platelets, leukocytes and cytokines. In comparison to platelet rich plasma, PRF has several distinct advantages, including simplicity of obtaining, sustained release of bioactive material and enhanced biological stability.[5,6]

L-PRF has more leukocytes present in the fibrin matrix and is known to have an effect on angiogenesis, osteoblastic activity and bone remodelling due to slow release of growth factors such as platelet derived growth factor, transforming growth factor-beta and vascular endothelial growth factor. Such biological effects can facilitate faster orthodontic tooth movement through tissue remodelling and inflammation.[7,8]

Some recent studies examining L-PRF use in the retraction of dogs have demonstrated higher incidences of tooth movement and better alveolar remodelling. Nevertheless, there are not many such studies available to date and those that are, do not provide consistent results owing to differences in their methodologies of conducting research. Split-mouth design is more reliable in making comparisons because the inter-subject variation is eliminated due to each subject acting as their own control. Thus, in order to examine the effect of L-PRF on orthodontic tooth movement, this study was designed.

METHODS

The present in-vivo split-mouth clinico-experimental study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics at D.J. College of Dental Sciences and Research, Modinagar, Uttar Pradesh, to evaluate the effectiveness of leukocyte platelet-rich fibrin (L-PRF) on orthodontic tooth movement during canine retraction.

Study duration

Study duration was from August 2025- November 2025.

The experiment involved a total of nine individuals who required bilateral extraction of their maxillary first premolars as a result of orthodontics. Both male and female participants within the age range of 15 to 25 years, with periodontally sound teeth and no systematic conditions that would affect the metabolic process within bones, were recruited for the research. Individuals who consumed medicines interfering with orthodontic tooth movements, like non-steroidal anti-inflammatory drugs or hormonal therapies, were excluded from the experiment. In addition, subjects having any parafunctions, unilateral mastication, skeletal crossbites, occlusal interferences, craniofacial anomalies, temporomandibular disorders and prior adjunctive acceleration techniques like corticotomy, piezocision, micro-osteoperforations, low-level laser therapy or vibration therapy were ruled out.

The G Power software version 3.1.9.7 was used for the sample size calculation based on the effect size of 1.444 and power of 90%, at a significance level of 5%. The calculated sample size came out to be nine subjects. Due to the split-mouth approach adopted in the research, each participant acted as their own control subject.

All patients had their maxillary first premolars extracted under local anesthesia. For each patient, the right maxillary side was considered the experimental side, while the left side was considered the control side. Immediately after extracting the tooth on the experimental side, L-PRF was prepared and introduced to the extraction socket. Approximately 10 ml of blood was harvested from the brachial vein via sterile syringes and introduced to sterile vacuum bottles without any anticoagulant. The blood was then centrifuged at a speed of 2700 rpm for 12 minutes. Three layers formed during centrifugation: the red blood corpuscles formed the bottom layer, while the acellular plasma formed the top layer. The intermediate layer consisted of the fibrin clot that was rich in platelets and leukocytes. This layer was removed approximately 2 mm below the interface, cut into the appropriate size and introduced into the extraction socket on the experimental side. The extraction socket was closed using 4-0 suture materials. Extraction sockets on the control side were allowed to close on their own without the use of L-PRF.

All subjects were provided orthodontic treatment using a standardized MBT prescription appliance. Reinforcement of the anchorage was accomplished by Group A anchorage, which consisted of a trans palatal arch and mandibular anchorage reinforcement in order to avoid mesial migration of posterior teeth during canine retraction. After levelling and alignment were completed, canine retraction was started with the use of 0.019"×0.025" stainless steel wires. Nickel-titanium closed coil springs with 9 mm length, producing constant force of 150 g were used for canine retraction. Mechanics of tooth movement were assessed and renewed in four-week intervals during the entire study. Orthodontic tooth movement measurement was done with the help of three-dimensional dental models. Impressions were made at the baseline time

point before starting canine retraction T0 and T1, T2 and T3 after the beginning of the procedure. Casts were scanned digitally and examined by three-dimensional imaging. Canine movement was measured at every follow-up appointment on the experimental and control side. Digital model analysis was chosen for its increased reliability and consistency of results. Centrifugation and L-PRF processing were standardized with the help of an external laboratory for consistent performance. Clinically, all procedures were done by a single operator to reduce procedural bias.

The data obtained were collected and analyzed using IBM SPSS Statistics software version 25.0 (IBM Corp., Chicago, USA). The amount of canine retractions measured at various time periods was expressed through descriptive statistics such as mean and standard deviation. Comparing the amount of retractions between L-PRF and control sites was done using paired t-test. Time-related changes in tooth movement within each experimental and control group were evaluated using repeated measures analysis of variance (ANOVA), followed by post hoc Bonferroni analysis.

Ethical approval

Ethical approval for the study was obtained from the Institutional Ethical Committee prior to commencement of the study and written informed consent was obtained from all participants.

RESULTS

Variations were seen in the amount of orthodontic tooth movement for the L-PRF group over the periods of observation, with more movements occurring after the first month followed by stabilization after the second month. The study included nine participants who completed the three-month observation period. The mean age of the participants was 21.22±2.64 years, ranging from 17 to 25 years. Four participants (44.4%) were males and five (55.6%) were females (Table 4). The same was evident for the control group with progressive amounts of tooth movement, with significantly low amounts during the first interval when compared to other intervals. On the control side, a similar time-dependent variation in orthodontic tooth movement was observed ($p<0.001$). Mean movement increased from 0.20±0.17 mm during T0–T1 to 0.63±0.27 mm during T1–T2, followed by 0.58±0.22 mm during T2–T3. The cumulative movement from T0 to T3 was 1.41±0.42 mm (Table 2).

A consistent comparison was found between the two groups whereby the tooth movement of L-PRF was much higher than the control one through the periods of observation. Statistically significant differences were found during the initial period of retraction, while no significant differences were recorded in the later intervals and the whole process cumulatively between the groups despite higher movements in the L-PRF group. On the L-PRF-treated side, orthodontic tooth movement varied significantly across the different observation intervals ($p<0.001$). The mean movement was 0.32±0.23 mm during T0–T1, increased to 0.67±0.25 mm during T1–T2 and was 0.61±0.17 mm during T2–T3. The cumulative movement from T0 to T3 was 1.60±0.43 mm (Table 1).

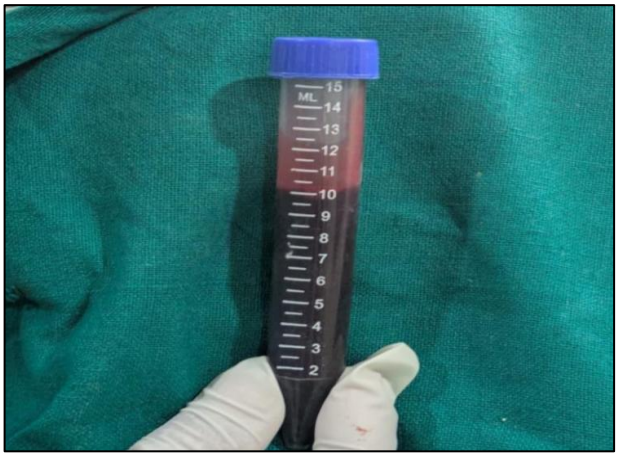

Figure 1: Collected blood in vacutainer tube.

Figure 2: Centrifuge parameters for L-PRF preparation.

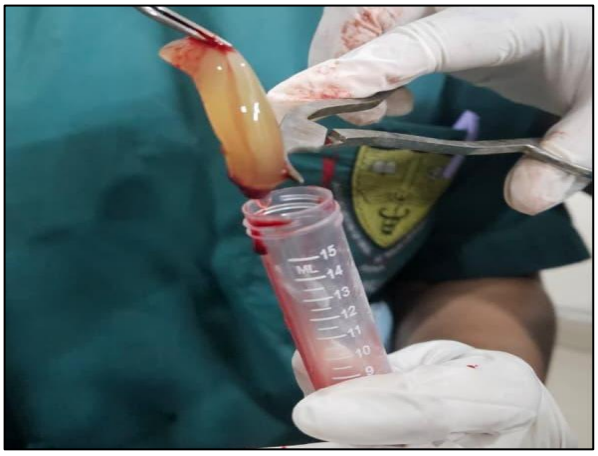

Figure 3: Extraction of the L-PRF plug.

Figure 4: Placing of L-PRF plug into the extraction socket.

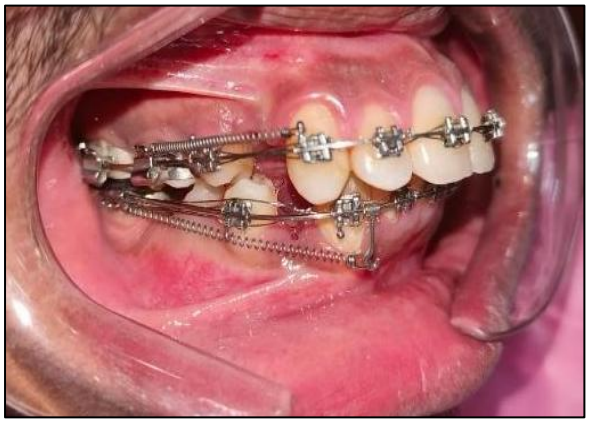

Figure 5: Retraction of canine using NiTi closed coil spring.

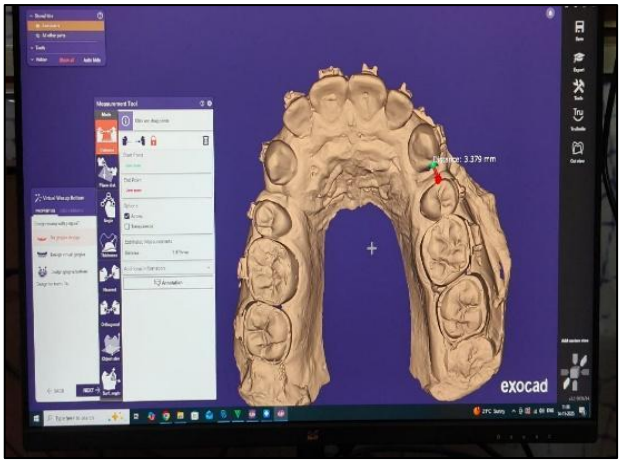

Figure 6: Measurement of canine retraction rate using 3D software.

A significant difference was identified between the initial and the other intervals of observation in the post hoc analysis, which implies that there was more tooth movement after the first month of observation. No significant difference was noted between the intermediate and later intervals.

Comparison between the two sides showed greater orthodontic tooth movement on the L-PRF side at all evaluated intervals. During T0–T1, movement was significantly greater with L-PRF (0.32±0.23 mm) than on the control side (0.20±0.17 mm; p=0.04). However, differences during T1–T2 (p=0.16), T2–T3 (p=0.85) and cumulative T0–T3 movement (p=0.10) were not statistically significant (Table 3).

Table 1: Descriptive statistics of orthodontic tooth movement in the L-PRF group across different time intervals.

L-PRF group							ANOVA
Time interval	**N**	**Mean**	**Std. deviation**	**Std. error of mean**	**Minimum**	**Maximum**	**P value**
T0- T1	9	0.32	0.23	0.08	0.14	0.85	
T1- T2	9	0.67	0.25	0.08	0.40	1.12	
T2-T3	9	0.61	0.17	0.06	0.39	0.78	0.000**
T0-T3	9	1.60	0.43	0.14	1.10	2.34	
Total	36	0.80	0.56	0.09	0.14	2.34	

*Statistically significant.

Table 2: Descriptive statistics of tooth movement in the control group across different time intervals.

Control group							ANOVA
Time interval	**N**	**Mean**	**Std. deviation**	**Std. error of mean**	**Minimum**	**Maximum**	**P value**
T0- T1	9	0.20	0.17	0.06	0.02	0.53	
T1- T2	9	0.63	0.27	0.09	0.32	1.18	
T2-T3	9	0.58	0.22	0.07	0.29	0.90	0.000**
T0-T3	9	1.41	0.42	0.14	0.89	2.23	
Total	36	0.70	0.53	0.09	0.02	2.23	

*Statistically significant.

Table 3: Comparison of mean orthodontic tooth movement between L-PRF and control groups across time intervals.

Time intervals	Group	N	Mean	Std. deviation	Std. error mean	Paired t-test (P value)
T0-T1	L-PRF	9	0.32	0.23	0.08	0.04*
	Control	9	0.20	0.17	0.06	
T1-T2	L-PRF	9	0.67	0.25	0.08	0.16
	Control	9	0.63	0.27	0.09	
T2-T3	L-PRF	9	0.61	0.17	0.06	0.85
	Control	9	0.58	0.22	0.07	
T0-T3	L-PRF	9	1.60	0.43	0.14	0.10
	Control	9	1.41	0.42	0.14	

*Statistically significant.

Table 4: Demographic data of patients.

Characteristics	Value
Age (in years), Mean±SD	21.22±2.64
Age range (years)	17–25
Male, n (%)	4 (44.4%)
Female, n (%)	5 (55.6%)
Total participants	9 (100%)

DISCUSSION

Orthodontic tooth movement is a biologically regulated process involving periodontal ligament remodelling, inflammatory mediator release and alveolar bone turnover. Recently, autologous platelet concentrates have gained attention as biologic adjuncts capable of enhancing orthodontic tooth movement. Leukocyte platelet-rich fibrin (L-PRF), because of its sustained release of growth factors and cytokines, has been proposed to stimulate bone remodelling and enhance the regional acceleratory phenomenon during canine retraction.[9] The effect of L-PRF on orthodontic tooth movement was assessed in the current study with a split-mouth method and greater tooth movement was observed in the L-PRF-treated site during the course of observation. From the results of the current study, it could be seen that there was greater canine tooth movement for the L-PRF-treated site than for the control site, especially in the early period of canine retraction. Statistically, significance was seen in the earlier interval while greater tooth movement without any statistical significance was observed in the subsequent intervals on the L-PRF site.

This indicated that biologically L-PRF was more effective in the early stages of orthodontics than in the later stages. Gradually decreased tooth movement could be due to the degradation of the fibrin scaffold and decreased growth factor secretion during later intervals. This result agrees with the biological behavior of L-PRF where the secretion of growth factors such as platelet-derived growth factor, transforming growth factor-β and vascular endothelial growth factor takes place mainly in the first few weeks of application.[11,12] The time course seen in the current research is also in agreement with those of Gupta et al and Satapathy et al who both recorded a higher rate of canine movement in the initial period after the use of L-PRF.[13,14] In a similar way, Tehranchi et al showed faster movement initially followed by stability in the subsequent stages, thereby suggesting that the stimulating effect of platelets can be short-lived rather than persistent throughout the entire process.[8] The same was true according to reports by Ishwarya et al, who recorded increased movement within the initial month of L-PRF application.[9]

Both the experimental and control groups demonstrated significant interval-based variations in tooth movement, indicating that physiologic remodelling associated with orthodontic mechanics naturally fluctuates during treatment. The increased movement observed during the intermediate phase may be related to enhanced osteoclastic activity and periodontal ligament remodelling following orthodontic force application.[15] Therefore, although L-PRF appeared to enhance tooth movement, part of the acceleration observed may also reflect the normal biologic response associated with orthodontic tooth movement itself.

The present findings further support the role of L-PRF as a minimally invasive alternative to surgically assisted acceleration procedures such as corticotomy, piezocision and micro-osteoperforations. Although these procedures are capable of accelerating tooth movement, they are associated with surgical trauma, postoperative discomfort and patient apprehension.[16] In contrast, L-PRF provides biologic stimulation through autologous growth factor release without extensive surgical intervention, making it a clinically acceptable adjunctive method for patients seeking minimally invasive treatment options. Another important observation in the present study was that the

acceleration associated with L-PRF was not sustained throughout the observation period. The highest rate of movement was recorded during the mid-phase, followed by a gradual decrease during subsequent phases. Similar results were documented by Barhate et al and Krishna et al both of whom found that the maximum advantages from the use of L-PRF occur during the first few weeks post-insertion.[7,17]

On the other hand, the minimal acceleration found by the other studies occurred because they had started their application of the orthodontic force after several weeks since insertion of L-PRF.[18]

One of the strengths of the current investigation is that a split mouth technique was adopted, meaning that the subjects acted as their own controls. This greatly reduced the influence of individual biological variables, such as systemic variables, on the outcome measures. Unfortunately, the study involved only a small number of subjects and lasted only for a short period of time; therefore, it would be difficult to find significant differences between groups. Additionally, no biochemical analysis of growth factors was conducted.

Although these limitations exist, this study adds to the accumulating body of evidence favoring the application of L-PRF in orthodontics. The results show that there may be some beneficial effects from the use of L-PRF in early acceleration of canine retraction, with no morbidity involved as a result of the procedure. Further research is needed with a large number of participants to determine the biologic processes involved in the use of L-PRF.

Limitations

Small sample size

The modest sample size limits the generalizability of results & increases the risk of type II error.

Short follow-up duration

Only the initial 3 months of retraction were assessed; long-term effects of L-PRF on movement or anchorage were not evaluated.

Cytokine profiling not performed

No biochemical assessment (IL-6, RANKL, OPG, TNF-alpha) was done, limiting biological correlation with movement patterns.

Inter-individual biological variability

Variations in platelet count and fibrin density of L-PRF plugs were not quantified.

Anchorage and root resorption not assessed

Potential side effects or benefits of L-PRF beyond rate of movement were not studied.

CONCLUSION

In the present study, it was found that the L-PRF resulted in a slight improvement in the speed of orthodontic tooth movement, especially in the initial stages of canine retraction. The biological effect seemed to be dependent on time, whereby it was greater at the beginning and had less impact later on. Even though the total amount of the improvement was not great, L-PRF was found to be a safe and effective means of accelerating orthodontic tooth movement.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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