



COMPARATIVE EVALUATION OF THE RATE OF CANINE RETRACTION USING L-PRF ASSISTED EXTRACTION VERSUS CONVENTIONAL EXTRACTION –A RANDOMISED CONTROL TRIAL”

Orthodontics

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KEYWORDS

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INTRODUCTION

Tooth movement is a physiologically rate-limited process where forces applied to teeth are transmitted through the periodontal ligament into alveolar bone causing it to either resorb or grow. When applying mechanical forces to the tooth supporting structure cell-signalling pathways are activated through numerous cascade reactions, which stimulate periodontal ligament (PDL) turnover and bone turnover.

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate that has many advantages over PRP as it precludes the use of anticoagulants, which are known to inhibit wound healing.¹ In addition, PRF results in the release of growth factors seven times greater than that released by PRP² such as platelet-derived growth factor (PDGF), transforming growth factor β (TGF- β), and vascular endothelial growth factor (VEGF), which play a crucial role in angiogenesis, collagen synthesis, and bone regeneration^{3,4}. This induced release is gradual and lasts for a longer period when compared with that induced by PRP.

Thus, the multitude of growth factors within the L- PRF that has the potential to stimulate both osteoblastic and osteoclastic activities together with its rich content of cytokines have a major role during orthodontic tooth movement.⁵⁻⁷

Hence a study was planned to explore the effect of using L- PRF in acceleration of orthodontic tooth movement during the canine retraction phase at different time intervals. In addition to this objective, the present study also aimed to assess the level of patient discomfort following the extraction and placement of the L-PRF plug

Aims & Objectives

1. To evaluate the effect of L-PRF in the rate of orthodontic tooth movement during canine retraction phase. (Primary objective)
2. To compare the change in the rate of orthodontic tooth movement with L-PRF application in the extraction socket as compared to normal secondary healing at different time intervals. (Secondary objective)
3. To assess the patient discomfort accompanying L-PRF placement in the extraction socket compared to the control side. (Secondary objective)

MATERIALS & METHOD

Sample size⁸ was determined using the mean and standard deviation values from literature using the formula

$$n = 2 \frac{(Z_{\alpha} + Z_{\beta})^2 [s]^2}{d^2}$$

where Z_{α} is the z variate of alpha error i.e. a constant with value 1.96, Z_{β} is the z variate of beta error i.e. a constant with value 0.84

Approximate estimates:

1. 80% power
2. Type I error to be 5%
3. Type II error to be 20%
4. True difference of at least 1.1 units between the groups
5. Pooled standard deviation of 1.23

$$\text{Substituting the values, } n = 2 \frac{(2.8)^2 [1.23]^2}{(1.1)^2}$$

$$n = 19.60$$

Hence 20 subjects / patients per group were selected to complete the trial at the endpoint follow up.

Inclusion Criteria:

1. Adult healthy patients, Male and female.
2. Age range: 15-27 years.
3. Angle's Class I malocclusion with bimaxillary protrusion
4. Mild to moderate crowding.
5. Permanent dentition
6. Presence of full complement of maxillary teeth (except third molars).

Exclusion Criteria:

1. Medical problems that affect tooth movement (use of corticosteroid, NSAIDs, patients treated with anticoagulants)
2. Patients having contraindications for oral surgery (Medical - Social - Psychological)
3. Presence of primary teeth in the maxillary arch.
4. Craniofacial anomalies (cleft lip and palate patients).
5. Patients with immunodeficiency disorders.

Methodology

Ethical clearance was obtained from the Institutional Ethical Committee (475/EC/2019) Informed consent was obtained from patients and/or legal guardians, prior to recruitment. 20 subjects who fulfil the selection criteria reporting to the Department of Orthodontics and Dentofacial Orthopaedics for orthodontic treatment and requiring therapeutic extraction of the maxillary first premolars were selected for the study after obtaining an informed consent. A nance palatal button was soldered to the maxillary molar bands to reinforce anchorage. The initial phase of alignment and levelling were completed for each of the sample using 0.018 inches MBT prescription brackets. This was followed by delayed extraction of the maxillary first premolars. The patients selected were randomly allotted by a computerized automated randomisation method to decide the side of intervention. During the extraction appointment, allocated and concealed envelopes bearing the details of the intervention side were handed over to the surgeon to determine the side of intervention. (Fig.1)

Two test- tubes were taken, 8ml blood was withdrawn from the median cubital vein and collected in the first test- tube without anticoagulant. The test tube was sealed securely and placed into the centrifuge machine. A second test-tube containing plain water was filled and mounted diagonally to the first test- tube in the centrifuge machine to balance the centrifugal forces in the machine.

The machine was set for centrifugation at 3000rpm for 10 minutes. L- PRF was prepared after centrifugation (Fig.2). The supernatant liquid was aspirated and the L-PRF layer was utilized for placement in the extraction socket. The extraction was performed under local anaesthesia infiltration using 2% lignocaine with 1:200000 adrenaline. The L-PRF plug was placed into the socket and sutured with silk sutures to hold the L-PRF in place. The control side underwent routine intra-alveolar extraction followed by primary closure with sutures (Fig.3).

A questionnaire was given to the patients to study their acceptance and to assess pain using Visual Analogue Scale (VAS) 1 (No Pain) - 10 (Worst Pain) and instructed to mark the score at 1 hour and 24 hours after the procedure.

The canine retraction phase began after 7 days of the procedure using a

closed nickel- titanium coil springs applying 150 g of force per side at the same time on a 0.016x0.022 inches SS wire. It was continued until canine retraction was completed (Fig.4).

Alginate impressions was made at 7days (T1), 15 days (T2), 1 month(T3) and successively at monthly intervals (T4, T5, T6) for approximately 6 months until canine retraction is complete to prepare study models and measure the amount of Orthodontic Tooth movement at each interval.

The distance (M1- M2) between the centre of the bracket of the maxillary canine (M1) and a perpendicular to the mesio-buccal cusp tip of the maxillary first molar (M2) was measured at each time intervals using sliding digital callipers to the nearest 0.1 mm after verifying the zero point. (Fig 5).

The measurements were recorded at each interval for both groups on all the study models by three assessors and the average value of the three readings were considered. The assessors were blinded regarding the side of intervention on each cast.

RESULTS

The data was analysed using IBM SPSS Version 21. Shapiro Wilk test showed that the numerical data followed a normal curve and hence parametric tests were applied. For Multiple comparison at different time interval Analysis of Variance was done and to assess which groups had significant results post hoc Tukey's test was done for rate of tooth movement at various intervals from T0-T7. For comparison between two groups, unpaired 't' test was used at various time interval of 1 hour and 24 hours, for VAS scale. Intra group difference was assessed with paired 't' test.

Assessment of pain was done with the help of a questionnaire using a VAS scale of 10mm which was handed over to the patient at 1 hour and 24 hours interval. The scores for both groups were tabulated and a comparison was done.

I. Comparison Of The Amount Of Tooth Movement (in mm) Between Experimental Group & Control Group At Different Time Intervals.

When comparison was done between both groups at different time intervals to assess the difference in distance travelled by the tooth (in mm), it was found that the distance of tooth movement in control group was more compared to the experimental group and this difference in the distance between control and experimental group was not statistically significant ($p>0.05$) (Table 1).

The distance between the molar and canine plotted against different intervals showed a similar trend in both groups; both groups reaching nearly the same endpoint for a given interval. (Table 2).

II. Comparison Of The Rate Of Tooth Movement Between Experimental And Control Group

The rate of tooth movement between experimental and control group was calculated at T0-T1 (7th day), T1-T2 (15th days), T2-T3 (1st month), T3-T4 (2nd month), T4-T5 (3rd month), T5-T6 (4th month), T6-T7 (5th months), T0-T7 (Total) (Table 3)

Overall Description :

The rate tooth movement in both the groups was not steady throughout the different intervals. The rate of canine retraction which was initially higher in the first 2 months, kept decreasing in the consecutive intervals was seen in both the experimental as well as control group.

Difference in the rate at each interval among both groups was statistically insignificant and thus the time taken for the canine retraction for the given interval was nearly the same in both the groups (Table 4)

Comparison Of Pain Using VAS Scale At 1 Hour And 24 Hours The Experimental And Control Group

When comparison of pain was done using The VAS score was compared at 1 hour and 24 hours for between the experimental and control group. The VAS score showed no statistical difference at different intervals. (Table 5,6)

DISCUSSION

Researchers have been studying the event of orthodontic tooth movement in terms of the sequence of inflammatory process and the

optimal force recommended.⁹⁻¹⁵ Several methods providing mechanical stimulation assisted by devices or surgery and using pharmacological agents have been tested to accelerate the velocity of the tooth movement.¹⁶⁻¹⁷

Comparison of the Rate of Canine Retraction in the Experimental Group:

The findings of the present study were similar to the study by Tehranchi et al¹⁸ who assessed the amount of canine movement for four months at 8 time intervals and observed that the average distance travelled by the maxillary canine in 4 months in the experimental group was 6.76mm. Tehranchi et al reported a rate of 1.69mm/month for the maxillary canines which was like the findings of the present study.

Comparison of the Rate of Canine Retraction in the Control Group:

The rate of individual canine retraction was found to be 1.358mm/month in the present study.

Comparison of the Rate of Canine Retraction Rate at Different Time Intervals in Both Groups:

The present study showed that the rate of canine retraction in different time intervals was not the same throughout. The canine retraction rate was high in the first 2 months and progressively reduced in the consecutive months in both the groups. The control group showed a higher rate of canine retraction than the experimental side during the first and second week. The following intervals showed a higher rate of tooth movement in the experimental group. The difference in the rate of canine retraction in both groups at different intervals was not clinically or statistically significant however, and hence there was no difference in the time taken for canine retraction in both groups. The higher rate of tooth movement after two months in the PRF side can be attributed to a steady release of growth factors from the scaffold of the PRF membrane inserted into the extraction socket.

These findings were in accordance with the study of T. S. Zeitounlouian et al¹⁹ who compared the rate of canine retraction by using injectable PRF vs conventional extraction in a split mouth study design and studied the month wise trends of retraction rate. He observed a higher rate of canine retraction in the 1st and 5th month on the control side and in the 2nd, 3rd and 4th months on the experimental side. However, the difference in the rate was statistically insignificant at each time interval like that of the present study. A similar finding was reported by Gupta S et al²⁰.

Yashwant V et al²¹ found that the rate of space closure in experimental quadrants (DMBM and PRF with PAAO technique) was found to be higher in comparison to control quadrants for all time intervals (T1-T4) in the PRF group. The comparative difference in the rate of extraction space closure between experimental quadrants of the PRF group and the DMBM group at different time points was however not significant statistically. The difference in the rate of tooth movement among both groups during each month was not statistically significant and hence the tooth moved to nearly the same distance in the given time interval in the present study.

Comparison of the Pain Perception at 1 Hour and 24 Hours of L-PRF Placement:

The pain perception recorded using a VAS scale of 10 mm in the present study found that the mean value was 2.4 and 2.6 at 1 hour and 24 hours interval respectively corresponding to a level of pain graded between no pain to moderate pain in both the groups.

The present study evaluated the effect of L- PRF in rate of orthodontic tooth movement at 1 week, 2 weeks and every consecutive month until canine retraction to understand the change in rate of tooth movement better across different time intervals. The amount and rate of tooth movement was thus determined not just at the end of one month but also in the initial few weeks unlike other studies in the past. The pain perception at two different time intervals were recorded to understand the extent of patient discomfort on placement of L-PRF before canine retraction which was also not performed in previous studies. The split mouth design of the present study helped control for selection bias and since the interventions were performed on the same individual, the difference in biological response, bone turnover, cellular mechanisms and bone biology could be eliminated.

The measurements in the present study were done manually using a digital Vernier calliper. This could account for human errors and could

be a limitation of the present study. However, to reduce the errors of measurement, three different assessors took the measurements and an average of the three was considered for the final analysis. The intra-rater coefficient by kappa statistics also showed good reliability to the readings.

CONCLUSION

- 1. There was no statistically or clinically significant difference in the rate of orthodontic tooth movement on L-PRF placement in the extraction socket of first premolar in experimental side as compared to conventional secondary healing.
- 2. The control side showed a higher rate of canine retraction than the experimental side in the first week and second week. The experimental side showed a higher rate of canine retraction in the consecutive time intervals. At the end of canine retraction phase, the difference in the rate among the two groups was statistically and clinically insignificant.
- 3. The pain levels perceived was graded as no pain to moderate pain on a VAS scale at both 1 hour and 24 hours in both the groups.

Future Research in this Area Could Focus on the Following:

- 1. Longer-Term Studies: Conducting studies with extended follow-up periods beyond 6 months to assess the long-term effects of L-PRF on orthodontic tooth movement and overall dental health. This would help determine any delayed benefits or complications that might emerge over time.
- 2. Different Dosages and Preparation Methods of L-PRF: Investigating the impact of varying concentrations of L-PRF or different preparation methods (e.g., longer centrifugation times or adjustments in blood volume) on the rate and quality of orthodontic tooth movement. This could help optimize the protocol for clinical use.
- 3. Comparison with Other Biomaterials: Exploring the effectiveness of L-PRF in comparison to other biologic agents (such as PRP, bone morphogenetic proteins, or hyaluronic acid) in enhancing tooth movement and promoting healing following tooth extractions.
- 4. Effects on Alveolar Bone Remodeling: Studying the effects of L-PRF on alveolar bone remodeling and the prevention of bone loss during orthodontic treatment, potentially leading to more stable long-term results.
- 5. Impact of L-PRF in Different Orthodontic Treatments: Investigating whether L-PRF enhances tooth movement in various types of orthodontic treatments, such as those involving different malocclusions, extraction patterns, or types of appliances.
- 6. Patient-Centered Outcomes: Focusing on patient-reported outcomes, including quality of life, comfort, and satisfaction with treatment when L-PRF is used, to further assess the clinical benefit of this adjunct therapy in orthodontics.

These studies would contribute valuable insights into optimizing orthodontic treatments using L-PRF and potentially improving outcomes for patients.

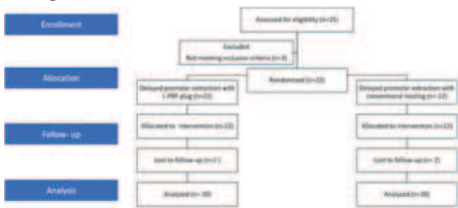


Figure 1 - Consort Flowchart



Figure 2- PREPARATION OF L- PRF- Collection of Blood, Placement of Tubes in Centrifuge Machine, L- PRF Formation, L- PRF Retrieval



Figure 3- L-PRF PLUG PLACEMENT- L- PRF Insertion in Extraction Sockets, Sutures Placed on Both Sides



Figure 4 – CANINE RETRACTION PHASE- Progress of Canine Retraction in Maxillary arch using 150g NiTi Closed Coil Springs

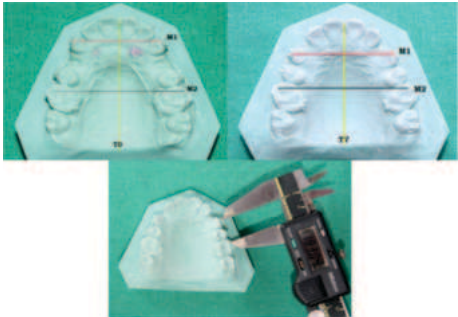


Figure 5- MEASUREMENT - Measurement of the Distance Between Canine Bracket and Mesiobuccal Cusp-tip of Maxillary First Molar Using Digital Vernier Calliper.

Table 1: Comparison Of Amount Of Tooth Movement Between Experimental And Control Group At Different Time Intervals

	Group	N	Mean	SD	Mean difference	T	P value
T0	Experiment	20	22.8440	1.62345	-.29000	-.597	.554
	Control	20	23.1340	1.44178			
T1	Experiment	20	22.0850	1.50633	-.19450	-.411	.683
	Control	20	22.2795	1.48344			
T2	Experiment	20	21.6565	1.38868	-.12150	-.271	.788
	Control	20	21.7780	1.44275			
T3	Experiment	20	19.9975	1.21377	-.23200	-.543	.590
	Control	20	20.2295	1.47508			
T4	Experiment	20	18.8185	1.25678	-.29700	-.634	.530
	Control	20	19.1155	1.67802			
T5	Experiment	20	17.6890	1.34127	-.07750	-.143	.887
	Control	20	17.7665	2.02017			
T6	Experiment	20	16.8815	1.57916	-.08550	-.149	.882
	Control	20	16.9670	2.02331			
T7	Experiment	20	16.0620	1.88901	-.27800	-.435	.666
	Control	20	16.3400	2.14534			

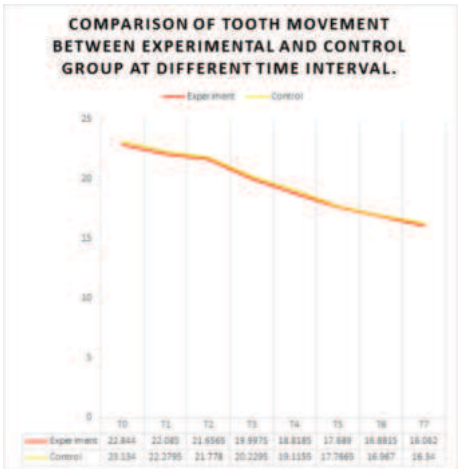


Table 2: Comparison Between Experimental And Control Group At Different Time Intervals

	Group	Mean	SD	Mean difference	95% CI		P value
					Lower	Upper	
T0-T1	Experiment	0.75	0.626	-0.096	-0.45	0.26	0.58
	Control	0.85	0.475				
T1-T2	Experiment	0.42	0.37	-0.07	-0.26	0.12	0.46
	Control	0.49	0.208				
T2-T3	Experiment	1.66	0.784	0.111	-0.41	0.63	0.671
	Control	1.54	0.854				

T3-T4	Experiment	1.17	0.781	0.064	-0.38	0.51	0.775
	Control	1.11	0.628				
T4-T5	Experiment	1.13	0.397	-0.218	-0.68	0.24	0.351
	Control	1.34	0.951				
T5-T6	Experiment	0.8	0.595	0.007	-0.38	0.39	0.971
	Control	0.79	0.633				
T6-T7	Experiment	0.819	0.699	0.192	-0.19	0.57	0.321
	Control	0.627	0.488				
T0-T7	Experiment	6.78	2	-0.013	-1.28	1.25	0.984
	Control	6.79	1.96				

Table 3: Comparison Of The Rate Of Tooth Movement Between Experimental And Control Group

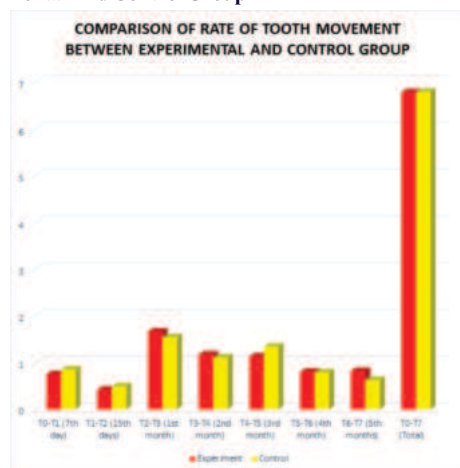


Table 4: Comparison Of Rate Of Tooth Movement Between Experimental And Control Group At Different Time Intervals

		Mean	Std. Deviation	Mean Diff	T value	P value
1 hr	Experimental	2.5000	.60698	-0.250	-1.365	.180
	Control	2.7500	.55012			
24 hr	Experimental	2.6000	.94032	.000	.000	1.000
	Control	2.6000	.59824			

Table 5: Comparison Of Pain Using VAS Scale At 1 Hour And 24 Hours Of Experimental And Control Group

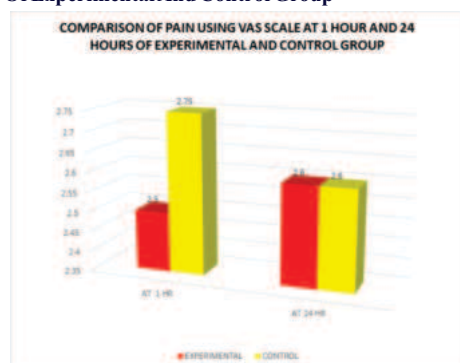


Table 6: Comparison Of Pain Using VAS Scale Between Experimental And Control Group At 1 Hour And 24 Hours Interval

Conflict of Interest

We have no conflict of interest

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