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Clinical evaluation and assessment of the efficacy of platelet rich fibrin (PRF) on the stability of orthodontic implant

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ABSTRACT

Introduction: The success of orthodontic treatment depends upon the anchorage. Mini-implants are widely been accepted as anchorage units, due to its size and convenience. However, implant failure is major concern. The placement of implant leads to micro-trauma leading to inflammation, and is found to be major reason of implant failure. Research to improve the stability of mini-implants are on rise. Platelet rich fibrin (PRF) is new generation platelet concentrate, which is found to increase the healing of tissues and hence used in trauma and surgeries. This study was undertaken to find whether PRF can enhance the stability of implant.

Materials and Methods: This single blind split mouth study comprised of 16 subjects above 18 years of age. Group A (consisted of 16 implants which were coated before insertion) and group B (16 implants were normally inserted). The stability of the implant was recorded using resonance frequency analysis at insertion (T0), 24 hours (T1), 2 weeks (T2), at 4 weeks (T3), at 6 weeks and 8 weeks after insertion.

Result: Statistically significant findings were found when group A was compared to group B using ANOVA test ($p<0.05$). The stability of implant of group A (experimental group) at each time interval was greater than group B (control group).

Conclusion: The stability of implants was found to be increased when they were coated with PRF than the normally inserted implant.

1. Introduction

Anchorage, defined as a resistance to unwanted tooth movement, is a prerequisite for the orthodontic treatment of dental and skeletal malocclusions.[1] The growing demand for orthodontic treatment methods that require minimal compliance and provide maximal anchorage control, particularly for adults, has led to the expansion of implant technology in orthodontics.[2]

The basic requirement for the success of orthodontic mini-implants is sufficient primary stability. Primary stability basically comes from mechanical interlocking with the cortical bone when the mini-implant is placed. It is influenced by bone quality and quantity, surgical technique, and screw geometry.[3]

Even though mini-implants are being extensively used, a major drawback of Orthodontic mini-implants is their failure rate. The reported failure rate of mini-implants varies from 6.6 to 16.1%.[4]

Mini-implant placement generates stresses and strains along the length of the screw that damage the surrounding bone. Too much damage can lead to micromotion of the implant and early loss due to lack of stability.[5]

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1.1. Research to improve the stability of mini-implants are on rise.

Platelet rich fibrin (PRF) is new generation platelet concentrate, a healing biomaterial, that has shown great potential for bone and soft tissue regeneration, without inflammatory reactions and may be used alone or in combination with bone grafts, promoting haemostasis, bone growth, and maturation. It consists of an autologous leukocyte-platelet-rich fibrin matrix[6] composed of a tetra molecular structure, with cytokines, platelets, and stem cells within it,[7,8] which acts as a biodegradable scaffold that favours the development of micro-vascularization and is able to guide epithelial cell migration to its surface.[7–10]

PRF may enhance the stability of mini-implants due to its healing property. Therefore, this study was undertaken to evaluate and assess the efficacy of PRF on the stability of orthodontic implant.

The present study investigated the effect of PRF on stability of mini-implants. A randomized clinical control trial was performed, with a focus on measuring the stability of mini-implant within the maxilla without loading following the extraction of first premolar teeth, to assess the effect of PRF on the miniimplant stability after 8 weeks using resonance frequency analysis, in comparison to that of the randomly allocated control group. The secondary outcomes expected was to evaluate the optimal loading time after the day of insertion of orthodontic micro-implants.

2. Materials and Methods

2.1. Trial design

The study was a single-centered, split-mouth randomized control trial to investigate the effectiveness of PRF on the stability of orthodontic mini-implant using resonance frequency analysis and secondary outcome.

2.2. Participants, eligibility criteria, and settings

The sample comprised patients who were undergoing comprehensive fixed orthodontic treatment with premolar extraction. Subjects who fulfilled the inclusion criteria (Table 1) were randomly allocated to 1 of the 2 groups. The lottery method of the simple random sampling technique was followed after informed consent was obtained from all the study subjects. On the one side was the test group (PRF group), and on the other side was the positive control (Non PRF) group. A total of 16 subjects were included in the study, and overall, 32 mini-implants were undertaken for assessment (16 mini-implants coated with PRF and 16 without PRF coating).

2.3. Sample size

A pilot study was done to determine the sample size of the 2 different groups of the study.[11] The values obtained from each group were calculated and the effect size was obtained using G* power 3.1.9.2. Subsequently, we obtained a sample size of 13 per group. To avoid unexpected errors, outcomes and dropout, the size was rounded up to 16 per group. The samples were split into 2 groups in which interventions were carried out (Figure 1):

1. Group 1: Among the patients in this group, the implants were coated with the PRF before insertion.
2. Group 2: Among the patients in this group, were not coated with PRF before insertion.

The fresh PRF was made for each patient by following the given procedure:

Around 2 ml of whole venous blood was drawn from cubital vein after torniquet application in upper arm (Figure 1). A 5ml syringe with 26-gauge needle was used for blood extraction and blood was collected in each of the two sterile vacutainer tubes (test tube) of 5ml capacity without anticoagulant. Following blood collection, the vacutainer tubes were then placed in a centrifugal machine (Figure 2) at 3000 revolutions per minute (rpm) for 10 minutes. The resultant product (Figure 3) consisted of following layers:

1. Top layer consists of straw-coloured cellular plasma.
2. Middle layer consists of platelet rich fibrin.
3. Bottom layer consists of R.B.C.

P.R.F and red corpuscle base was extracted using a sterile forceps from straw-coloured cellular plasma and then with help of a sterile scissor P.R.F. was cut-off from R.B.C and transferred onto a sterile dappen dish.16 implants were coated with PRF using zero size brush (Figure 4).

All the 18 titanium- Grade 5(Ti-6AI-4V) implants (1.5 x 6mm) were then inserted 8 mm from the alveolar crest between the upper first molar and premolar with a self-drilling method at 90º

The ISQ was measured using resonance frequency analyser at 6 different time intervals – at time of insertion(T0), 24 hours (T1), 2 weeks (T2), 4 weeks (T3), 6 weeks(T4) and 8 weeks(T5) after insertion in two directions i.e., mesiodistal direction (D1) and occlusogingival direction (D2). (Figures 4 and 5)

3. Result

3.1. Statistical analysis

The observations obtained in the study were subjected to statistical analysis, so as to get their interpretation. Data was coded, transferred and analysed on SPSS version 19. Mann Whitney test was used to compare the mean ISQ values measured in the two different directions and the ANOVA test was used for intragroup and intergroup comparison. Level of significance was set at $p<0.05$.

Statistically insignificant findings were observed when direction D1 i.e., Mesio-distal direction when compared to

Table 1: Inclusion and exclusion criteria of the study

Inclusion criteria	Exclusion criteria
1. Subjects whose treatment plan will comprise of a micro-implant placement	1. Subjects having systemic disease affecting bone metabolism (Osteoporosis, Paget's disease)/ wound healing (Diabetes)
2. Subjects with healthy periodontium	2. Subjects under any medications, steroids, bisphosphonates, calcium supplements
3. Subjects with good oral hygiene.	3. After insertion, data of subjects who missed examination appointments.
4. Age group above 18 years.	4. Subjects not willing to participate in the study.

Table 2: Comparison of the primary stability measured in the two directions for Group A bymann whitney U test.

Time interval	Mean Stability measured in direction 1	Mean stability measured in direction 2	p-value	Result
T0	62.94	62.81	0.727	Insignificant
T1	56.25	56.17	0.473	Insignificant
T2	46.54	47.15	0.76	Insignificant
T3	55.83	55.63	0.543	Insignificant
T4	59.23	59.29	0.703	Insignificant
T5	64.31	64	0.69	Insignificant
The mean ISQ between the direction D1 and D2 is statistically insignificant at any of the time periods for Group A.				

Table 3: Comparison of the primary stability measured in the two directions for Group Bmann whitney U test.

Time interval	Mean Stability measured in direction A	Mean stability measured in direction B	p-value	Result
T0	39.98	38.40	0.06	Insignificant
T1	35.83	36.15	0.54	Insignificant
T2	30.75	30.67	0.73	Insignificant
T3	36.19	37.04	0.16	Insignificant
T4	38.54	38.81	0.60	Insignificant
T5	42.27	42.90	0.22	Insignificant
The mean ISQ between the direction D1 and D2 is statistically insignificant at any of the time periods for Group B.				

Table 4: Intra group comparison of mean and standard deviation using in GroupA using ANOVA test

Group A	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max	F‘	Sig.
				Lower Bound	Upper Bound				
T0	61.55	3.772	.385	60.79	62.32	52	68	315.9	.00*
T1	56.21	3.172	.324	55.57	56.85	50	64		
T2	46.84	4.578	.467	45.92	47.77	40	58		
T3	55.26	2.796	.285	54.69	55.83	50	62		
T4	59.26	2.485	.254	58.76	59.76	53	66		
T5	64.16	2.773	.283	63.59	64.72	58	69		

Table 5: Intra group comparison of mean and standard deviation using in Group B using ANOVA test

Group B	Mean	Std. Deviation	Std. Error	.95% Confidence Interval for Mean		Min	Max	F	Sig.
				Lower Bound	Upper Bound				
T0	39.19	3.522	.359	38.47	39.90	32	48	159.8	.00*
T1	35.99	2.553	.261	35.47	36.51	32	45		
T2	30.71	4.292	.438	29.84	31.58	22	37		
T3	36.61	2.569	.262	36.09	37.14	25	43		
T4	38.68	2.763	.282	38.12	39.24	30	46		
T5	42.58	2.315	.236	42.11	43.05	37	46		

*Statistically significant values between time intervals

Table 6: Comparison of mean and standard deviation of Group A and Group B at different time interval

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max	Mean Difference
					Lower Bound	Upper Bound			
T0	Group A	61.55	3.772	.385	60.79	62.32	52	68	22.36
	Group B	39.19	3.522	.359	38.47	39.90	32	48	
T 1	Group A	56.21	3.172	.324	55.57	56.85	50	64	20.22
	Group B	35.99	2.553	.261	35.47	36.51	32	45	
T2	Group A	46.84	4.578	.467	45.92	47.77	40	58	16.14
	Group B	30.71	4.292	.438	29.84	31.58	22	37	
T3	Group A	55.26	2.796	.285	54.69	55.83	50	62	18.65
	Group B	36.61	2.569	.262	36.09	37.14	25	43	
T4	Group A	59.26	2.485	.254	58.76	59.76	53	66	20.58
	Group B	38.68	2.763	.282	38.12	39.24	30	46	
T5	Group A	64.16	2.773	.283	63.59	64.72	58	69	21.57
	Group B	42.58	2.315	.236	42.11	43.05	37	46	

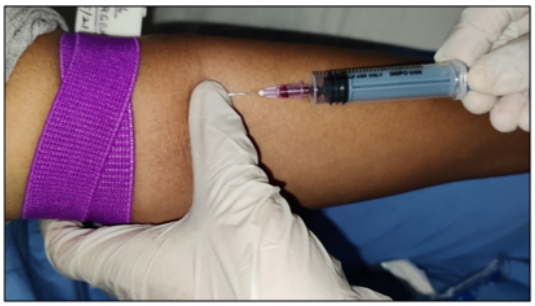


Figure 1: Blood withdrawal using 5ml syringe

Figure 2: Centrifugal machine

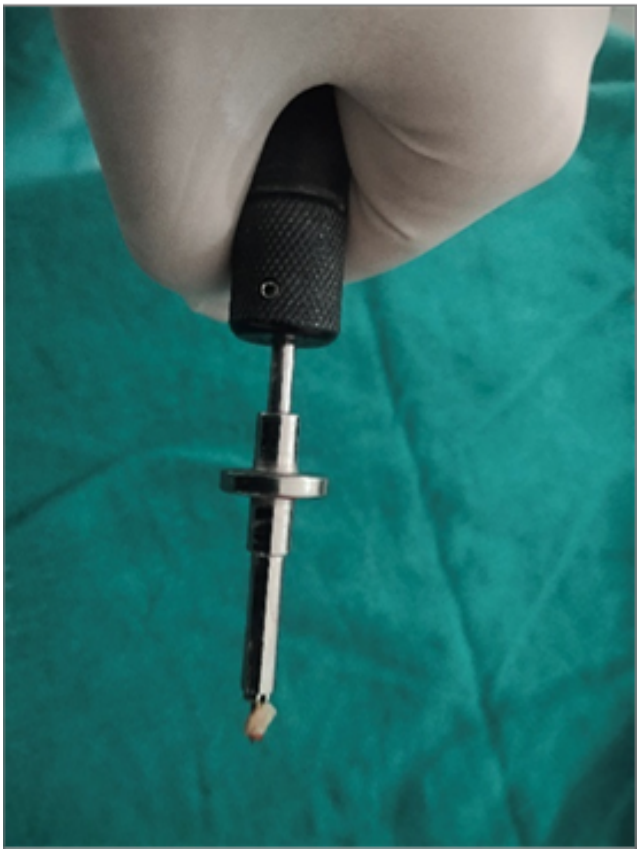


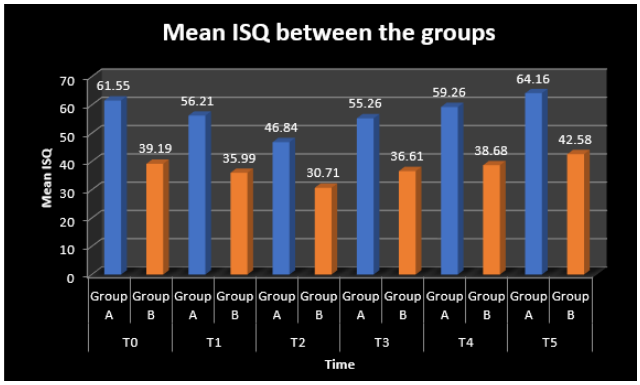
Figure 3: Micro implant coated with PRF

direction D2 i.e., Occluso-gingival direction using Mann Whitney test at T0, T1, T2, T3, T4 and T5 in both the groups. (Tables 2 and 3)

Statistically significant findings were found when group A (experimental group) was compared to group B (control group) using ANOVA test ($p<0.05$). The stability of implant

Figure 4: Reading inmesiodistal direction (D1).

Figure 5: Reading in occlusogingival direction (D2).



Graph 1: Comparison of Group A and Group B at different time interval

of group A at each time interval was greater than group B. (Tables 4 and 5) (Graph 1)

The difference in mean ISQ for the intragroup comparison by using ANOVA test was also found statistically significant. The implant stability was found to be high at T0 and reduces till T2 and then increases through T3 to T5 in both the groups. The stability was highest at T5. (Tables 6 and 5)

4. Discussion

In this study, statistically significant findings were found when group A (Experimental group) was compared to group B (Control group) using ANOVA test ($p<0.05$).

The stability of implant of group A at each time interval was greater than group B. This shows that implants coated with PRF have increased its stability suggesting PRF can significantly enhance the implant stability. This may be because it consists of an autologous leukocyte-platelet-rich fibrin matrix[6] composed of a tetra molecular structure, with cytokines, platelets, and stem cells within it,[7,8] which acts as a biodegradable scaffold[9] that favours the angiogenesis and is able to guide epithelial cell migration to its surface.[7,10] The mechanism which was followed here was that, fibrinogen which was initially concentrated in the high part of the tube, combined with the circulating thrombin due to centrifugation, to form fibrin. A fibrin clot was then obtained in the middle of the tube, just between the red corpuscles at the bottom and acellular plasma at top. Platelets were trapped massively in the fibrin meshes.[5]

In intragroup comparison of ISQ values at different time intervals were analyzed using ANOVA Test it was observed that the implant stability was higher at T0 and reduces till T2 and increasing through T3 to T5. The stability was lowest at T2 and highest at T5.

This shows that the primary stability of implant is best at the time of insertion, however the stability gradually declines from 24 hours till 2^{nd} week after implant insertion which may be due to inflammatory response of the adjacent tissues to the trauma caused at the time of implant placement. The stability then starts increasing after 2^{nd} week of implant stability shows that healing sets in after the initial inflammatory response and improves the stability. The highest ISQ value was shown at 8 weeks of duration. Suggesting that the best time to load the implants will be immediately after the placement of the implant or after 8^{th} week of insertion of implant.

With above findings we can also conclude that the best time of loading the implant is at the time of insertion i.e., immediate loading is recommended.

The result of this study could not be compared with any other studies as there were no studies found regarding use of PRF with mini-implants in the literature.

5. Conclusion

In this study, PRF coating has shown a promising result in terms of increase in stability of implants. So, with the use of PRF, the stability of mini-implants can be increased by chairside with minimally invasive procedure. There is a scope to evaluate the effect of PRF of micro-implants on primary stability with loading the mini-implants with an increased sample size for long period of time.

The limitation of this study is that it includes the limited sample size and the primary stability was measured without loading the micro-implants which would also affect the primary stability. Another drawback is that only a single type of micro-implants from a same company was used.

Further investigations using different types of mini-implants at different positions is recommended.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Papadopoulos MA, Tarawneh F. The use of miniscrew implants for temporary skeletal anchorage in orthodontics: a comprehensive review. *Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol*. 2007;103(5):6–15.
2. Garg KK, Gupta M. Assessment of stability of orthodontic mini-implants under orthodontic loading: A computed tomography study. *Indian J Dent Res*. 2015;26(3):237–43.
3. Singh A, Kannan S, Arora N, Bajaj Y, Revankar A. Measurement of mini-implant stability using resonance frequency analysis. *Angle Orthod*. 2018;83(2):230–8.
4. Schätzle M, Männchen R, Zwahlen M, Lang NP. Survival and failure rates of orthodontic temporary anchorage devices: a systematic review. *Clin oral Implants Res*. 2009;20(12):1351–60.
5. Pan CY, Chou ST, Tseng YC, Yang YH, Wu CY, Lan TH. Influence of different implant materials on the primary stability of orthodontic mini-implants. *Kaohsiung J Med Sci*. 2012;28(12):673–81.
6. Gupta V, Bains VK, Singh GP, Mathur A, Bains R. Regenerative potential of platelet rich fibrin in dentistry: Literature review. *Asian J Oral Health Allied Sci*. 2011;1(1):23–31.
7. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part II: platelet-related biologic features. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2006;101(3):45–50.
8. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2006;101(3):56–60.
9. Li Q, Pan S, Dangaria SJ, Gopinathan G, Kolokythas A, Chu S. Platelet-rich fibrin promotes periodontal regeneration and enhances alveolar bone augmentation. *Biomed Res Int*. 2013;p. 638043. doi:10.1155/2013/638043.
10. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part III: leucocyte activation: a new feature for platelet concentrates? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2006;101(3):51–5.
11. Kaurani H, Daokar S, Vilas S, Deepakrao S, Jaywant T. Innovative Method to Increase the Stability of Mini-Implant. *J Res Adv Dent*. 2022;13(1):107–11.

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