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Comparison of the Effectiveness of Injectable Platelet Rich Fibrin and Microosteoperforation on En Masse Retracton of Maxillary Anterior Teeth: Comparitive Study

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Abstract:

- ***Background and Objective:***

One of the primary concerns for orthodontic patients is the duration of treatment. Shortening this time involves carefully managing the treatment process from the very beginning.[1] Studies have shown that bone resorption is the key factor that limits the speed of tooth movement. As a result, techniques that enhance osteoclast activity can help increase the pace of orthodontic tooth movement. Several methods aimed at accelerating orthodontic treatment have been developed, though their outcomes have been inconsistent.

Injectable platelet-rich fibrin (i-PRF) and micro-osteoperforations (MOP) are among the least invasive surgical techniques, as MOP does not require raising a full-thickness flap. Both approaches promote the activity of osteoclasts and osteoblasts. Notably, i-PRF significantly increases the levels of RANKL, MMP8, and IL-1β—key factors involved in bone remodeling. This study aimed to compare the effectiveness of i-PRF and MOP in enhancing the rate of space closure during en masse retraction of the maxillary anterior teeth.

- ***Methods:***

Twenty-four patients undergoing orthodontic treatment at K.V.G. Dental College and Hospital, all requiring extraction of the maxillary first premolars, were selected and divided into two groups of 12: the i-PRF group and the MOP group. In the i-PRF group, injections were administered into the distobuccal and distolingual periodontal ligament spaces of the maxillary canines twice—once immediately before the start of en masse retraction and again at the second week of retraction. Local anesthesia was used prior to the injections to ensure patient comfort.

- ***Results:***

The rate of space closure was similar in i-PRF group anf MOP group and the difference between the two groups was not statistically significant...

- ***Interpretation and Conclusion:***

It was concluded that both injectable platelet rich fibrin and MOP minimally invasive procedure had similar rate of tooth movement which could be an effective enhancing orthodontic treatment efficiency by accelerating tooth movement.

Keywords *En-masse retraction; injectable platelet rich fibrin; Microosteoperforation; accelerated orthodontics; orthodontic tooth movement.*

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I. INTRODUCTION

In recent years, there has been a significant rise in advancements within orthodontics aimed at reducing treatment time, particularly for adult patients.[1] Orthodontic treatment typically lasts between 18 to 24 months, though this duration can extend further based on the severity of the malocclusion, the chosen treatment approach, missed appointments, individual patient characteristics, level of cooperation, and age.

Various surgical like dentoalveolar distraction osteogenesis, laser, mechanical, pharmacological and electromagnetic methods have been widely used for accelerating the tooth movement to obtain the desired results by modifying the biological response of tissue.[3] Blood-derived platelet-based preparations from patients offer a secure substitute for commercially available bioactive materials. Platelet-based concentrations are used indifferent fields of medicine, dentistry to accelerate tissue healing and regeneration as they have a wide variety of proteins and growth factors.[4]

The patient's blood is used to create platelet-based preparations, A liquid injectable platelet rich fibrin was developed by modifying spin centrifugation rate and without adding any anticoagulants and additives. i-PRF affects osteoblastic behavior remarkably by influencing its migration, proliferation, and differentiation.[5-6] This promotes cellular activity and accelerates bone turnover and healing.

The purpose of microosteoperforations, which are currently used to reduce the bone density surrounding teeth while preserving the bone density surrounding anchor teeth unchanged, is to create small, shallow, flapless osteoperforation between a tooth's buccal or lingual roots on the surface of cortical plates. When the tooth is moved into an edentulous space, as in extraction cases, this treatment has been reported to be particularly beneficial.[7] Micro osteoperforations have been suggested as a low cost, safe, minimally invasive method that can be used to minimize treatment intervals and speed up orthodontic tooth movement

However, no significant studies have been performed pertaining to the assessment of comparision of effective usage of i-PRF and microosteoperforation in en-masse retraction. Therefore the purpose of this study will be to compare the rate of en-masse retraction in the two groups, where i-PRF is used in one group and microosteoperforation in another group

➢ *Aim and Objectives of the Study Aim*

To assess the comparision of the effectiveness of injectable platelet rich fibrin and microosteoperforation on the rate of tooth movement in the en masse retraction of emaxillary anterior teeth.

➢ *Objectives*

- To evaluate the rate of tooth movement during en-masse retraction of maxillary anterior teeth using injectable platelet rich fibrin.
- To evaluate the rate of tooth movement during en-masse retraction of maxillary anterior teeth using microosteoperforation.
- To compare the effects of injectable platelet rich fibrin and microosteoperforation in the rate of en-masse retraction of maxillary anterior teeth.

II. MATERIALS AND METHODS

➢ *Sources of the Data:*

Patients seeking orthodontic treatment at the Department of Orthodontics,

- K.V.G Dental College and Hospital, Sullia Sample Size: 12 Patients in each group
- Age Group- 18-25 years Type of study : In vivo study Period of study:3months
- Place of study : The study will be conducted in the Department of Orthodontics, K.V.G Dental College and Hospital, Sullia, Dakshina Kannada.

➢ *Study Design :*

Prospective in-vivo study

➢ *Sample Size Estimation*

Using the formula,

- n= 2(SD)2(Z1-α/2 + Zβ)2 (d)2
- Where, SD = STANDARD DEVIATION
- Z1-α/2 = 1.96 AT 95% CONFIDENCE INTERVAL
- Zβ = 0.84 AT 80% power
- d = MEAN DIFFERNCE - 0.2 SUBSTITUITING THE VALUES, WE GET **n = 11.32**
- Further assuming 10% sampling loss to follow up during treatment n=12
- *Therefore The Final Sample Size of the Study Is 12 Per Group.*

III. METHOD OF COLLECTION OF DATA

Patients who meet the eligibility criteria and choose to participate in the study will be required to sign a consent form after being fully informed. During the course of treatment at the beginning of retraction phase, one group will act as i-PRF on both sides of maxillary arch where as in the another group microosteoperforation is used in this study design.

➢ *Sampling Methodology:*

A prospective, single center, randomized sampling methodology will be employed in sampling

➢ *Study Setting*

The study will be conducted in the Department of Orthodontics, KVG Dental College and Hospital, Sullia, Dakshina Kannada.

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➢ *Selection Criteria: Inclusion Criteria*

Patients who need fixed appliance with extraction of first premolars

- Patients with full permanent dentition (with or without the third molars)
- No bleeding on probing, no smoking.

➢ *Exclusion Criteria:*

- Patients with previous history of fixed orthodontic appliance treatment
- Patients who have previous history of systemic diseases
- Patients with congenitally missing anterior
- Patients with contraindication for extractions
- Patients with probing depth more than 3 mm and lack of sufficient attached gingiva
- Patient with bleeding disorder

➢ *Armamentarium*:

- MBT brackets - 0.022"slot and bonding materials (3M Unitek, Monorovia, California)
- Arch wires in standard sequence of MBT
- Stainless steel wires 0.019" x 0.025"
- Elastic modules (Ormco) and ligature wires(010"-Leone)
- 70% alcohol solution
- 10mL syringe
- Centrifuge tube
- Centrifuge machine with700rpm

- Hand driver and self-drilling mini-implants(SK surgical,1.5 x 8mm) (To create MOPs)
- Local anaesthesia (2% lidocaine with 1:80,000 adrenaline – Lignox 2% A, Indoco Remidies Ltd).
- 11.2mL syringe 12.Alginate
- Dental stone
- Digital caliper

IV. PROCEDURE

12 Patients of the age group 18-25 years who required maxillary first premolars extraction during the orthodontic treatment was selected for the study. The patient provided written consent after the procedure was thoroughly explained..12 patients was randomly assigned into I-PRF group and 12 patients into micro-osteoperforation group. All patients were treated with the pre-adjusted edgewise appliance system (MBT prescription, slot size 0.022 X 0.028 in) for en-masse retraction of maxillary anterior teeth after leveling and alignment.

Preparation of i-PRF and application

To prepare the i-PRF, an aseptic environment was built. After deciding the appropriate injector and area for blood collection, the area was cleaned with a 70% alcohol solution. In the study group the blood was drawn from brachial vein by using 10mL syringe. The drawn blood samples were immediately put into centrifuge tubes devoid of anticoagulants, and then centrifuged at a rate of 700 rpm for 3 minutes at room temperature. The centrifuged blood got divided into two components. The i-PRF collected from the upper liquid layer was loaded into a dental injector. In one group, i-PRF was administered into the distobuccal and distolingual periodontal ligament spaces of the maxillary canines twice—once immediately before en-masse retraction and again during the second week of retraction. Local anesthesia was administered beforehand to manage pain during the PRF injection.

Prior to the procedure, patients were instructed to rinse their mouths with chlorhexidine for one minute. Micro-osteoperforations were performed a single time by the principal investigator using standard aseptic techniques under local anesthesia (2% lidocaine with 1:80,000 epinephrine), employing self-drilling mini implants (SK Surgicals).The perforations were made at two specific regions: between the maxillary canine and lateral incisor on both sides, and within the extraction sites of the maxillary first premolars bilaterally. Three perforations were created at equal intervals distal to the canine within the extraction site, and two were placed mesial to the canine. Each perforation measured approximately 2 mm in diameter and 5 mm in depth. A sterile rubber stopper was used to mark the depth on the mini implant for guidance. Once the designated depth was reached, the mini implant was carefully removed by turning the screwdriver counter clockwise. Hemostasis was achieved by applying pressure with sterile cotton pellets. The technique was flapless and minimally invasive, and patients did not require any postoperative restrictions.

The total follow up duration will be of 3 months. Impression was taken before en- masse retraction (T0),5 th week (T1) and 12 th week(T2) From the beginning of the retraction. Study models were prepared by immediately pouring the impression with dental stone.

Assessment of the rate of en-masse retraction was carried out using dental casts. Tooth movement was determined by measuring the linear distance between the central point on the distal surface of the maxillary canine and the central point on the mesial surface of the maxillary second premolar. These measurements were taken separately for the right and left sides using a digital vernier caliper for accuracy.

V. STATISTICAL ANALYSIS

All statistical analysis will be performed by using the SPSS software. The mean and the standard deviation will be calculated for each variable. Analysis of the data between groups will be carried out using paired and unpaired t test. $P<0.05$ will be considered as statistically significant.

VI. RESULTS

Table no. 1 describes the comparison of basic demographic characteristics of age and Gender among study participants of the two groups of the study. Here the results obtained shows that in relation to both age and gender there is no statistically significant difference between the population chosen between the groups with the age and

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gender being comparable with each other among the groups. The graphically representation of the age categorisation has been shown in fig no. 1 and Gender categorisation among the groups shown graphically in fig. no. 2…

Table 1 Comparison of Age and Gender among Various Groups of Study Population

Parameter	PRF Group	MOP Group	p- value
Age (in years)	20.91± 2.53	22.33±1.55	0.144
Gender			
Males	4(33.3%)	6(50%)	0.6788
Females	8(66.67%)	6(50%)	

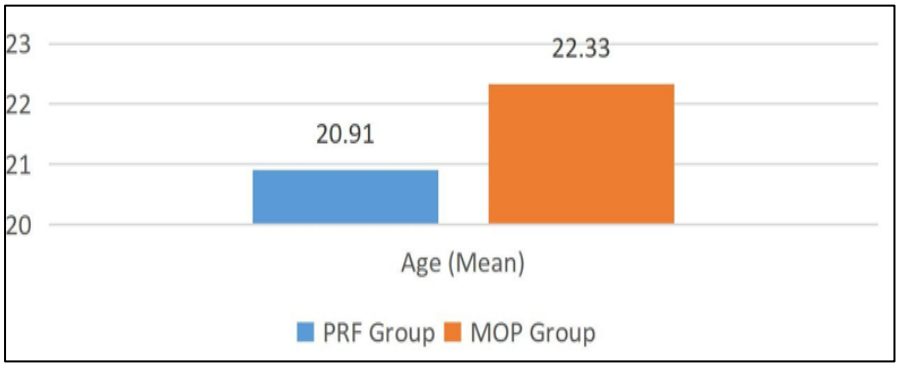

Fig 1 Comparison of Mean Age among the Group of the Study

Table no. 2 describes the inter group comparison of tooth movement between the two groups of the study at time points of baseline, 5th week and 12th week. The analysis here was done using unpaired t tests. The results obtained here indicated that at all the three time points of baseline, 5 weeks and 12 weeks there was no statistically significant difference between the tooth movement

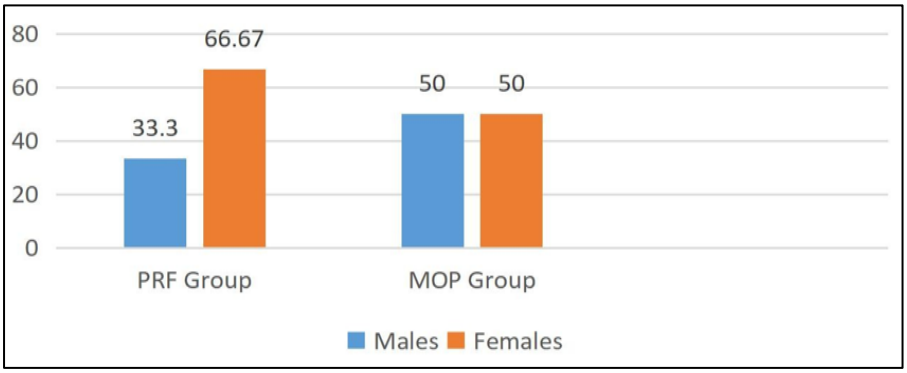

Fig 2 Comparison Gender (In Percentage) Among the Groups of the Study

between the groups with only minimal and negligible difference observed between them.. The same phenomenon has been graphically represented in fig.no. 3.…

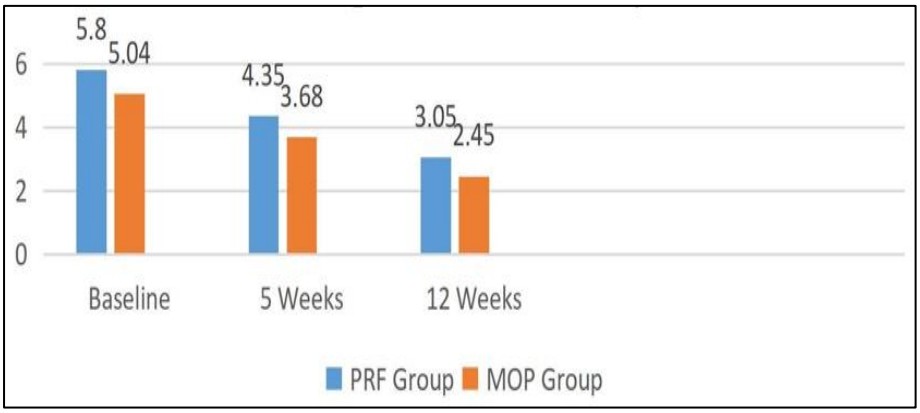

Fig 3 Inter Group Comparison of Mean Tooth Movement among Three Groups Following En-Masse Retraction of Maxillary Teeth at Various Time Periods of the Study

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Table no. 3 and table no. 4 indicates the intra group comparison of tooth movement between various time intervals in PRF group. Here the results obtained shows that there is a statistically significant decrease in the tooth movement/space available for closure observed over the time periods(p=0.00000489) with the highest observed at baseline and the lowest seen at 12 weeks. On further analysis using post hoc test we observed that in comparison with time periods of baseline there was a statistically significant difference seen at 5 weeks(p=0.0089), 12 weeks (p=0.0000027). Similarly in comparison with time period of 12 weeks, there was a statistically significant difference observed in relation to 5 weeks(p=0.0453). . Graphically representation of the same has been done in fig no. 4…

Table 3 Intra Group Comparison of Tooth Movement between Five Different Time Intervals in PRF Group Following En-Masse Retraction of Maxillary Teeth Using Using ANOVA Test

Groups	Baseline (T0)	5 Weeks (T1)	12 Weeks (T2)	P- Value
PRF Group	5.80±1.19	4.35±1.18	3.05±0.97	0.00000489

P<0.05 is considered as statistically significant

Table 4 Intra Group Comparison of Tooth Movement between Different Time Intervals in PRF Group Following En-Masse Retraction of Maxillary Teeth Using Post-Hoc Test

Parameter Side	Groups	Mean Difference	p- value
PRF Group	5 Weeks – Baseline	-1.45(-2.57, -0.32)	0.0089
	12 Weeks – Baseline	-2.75(-3.88, -1.63)	0.0000027
	12 Weeks – 5 Weeks	-1.30(-2.43, -0.18)	0.0199

P<0.05 is Considered as Statistically Significant

Table no. 5 and table no. 6 represents the intra group comparison of tooth movement between the various time intervals in MOP group. Unlike in the other two groups here the time intervals were only baseline, 5th week and 12th week. The results obtained here indicated that there was a statistically significant difference between the time intervals in the MOP group(p=0.00000000108) with the difference in tooth movement/space available for closure progressively decreasing from baseline to 12th week. On further analysis with tukeys post hoc test it was observed that the difference seen was uniformly distributed with the statistical significance being observed between every two time intervals as shown in table no 10. The graphical representation of the same can be seen in fig no. 4…

Table 5 Intra Group Comparison of Tooth Movement between Three Different Time Intervals in MOP Group Following En-Masse Retraction of Maxillary Teeth Using Using ANOVA Test

Groups	Baseline (T0)	5 Weeks (T2)	12 Weeks (T4)	P- Value
MOP Group	5.04±0.82	3.68± 0.67	2.45±0.56	0.00000000108

Table 6 Intra Group Comparison of Tooth Movement between Different Time Intervals in MOP Group Following En-Masse Retraction of Maxillary Teeth Using Post-Hoc Test

Parameter Side	Groups	Mean Difference	p- value
MOP Group	5 Weeks – Baseline	-1.35(-2.05, -0.65)	0.0001107
	12 Weeks – Baseline	-2.58(-3.27, -1.88)	0.0000000
	12 Weeks – 5 Weeks	-1.22(-1.92, -0.53)	0.0003905

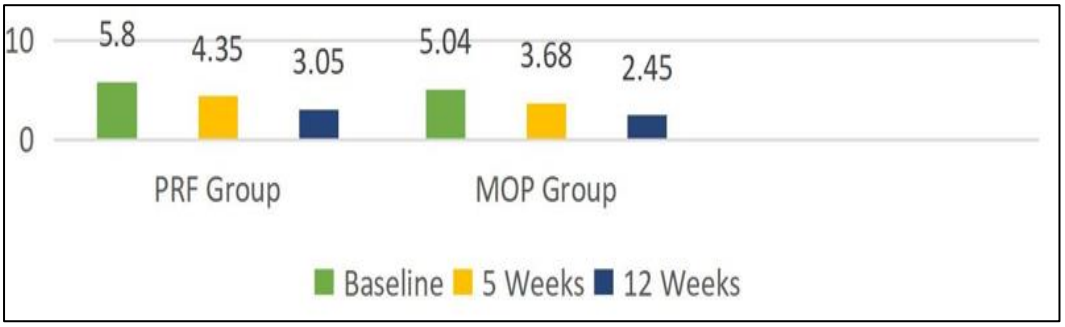

Fig 4 Intra Group Comparison of Mean Tooth Movement at Various Time Periods of the Study among Two Group Following En-Mssse Retraction of Maxillary Teeth

Table no. 7 represents the inter group comparison of mean difference of tooth movement between the groups during the mentioned time intervals of the study. The results obtained here shows that at the time interval of T0-T1 that is from baseline to 5 weeks, the amount of mean tooth movement/space closure seen is slightly higher among PRF group in comparison to MOP group but this difference is not statistically significant. Following on the with the same

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groups it was seen that at time interval of T1-T2 that is from 5 weeks to 12 weeks time interval, again the amount of tooth movement seen was higher in PRF group as compared to MOP group and again here the difference seen between groups was not found to be statistically significant. The mean difference of above mentioned time intervals has been graphically represented in fig no. 5…

Table 7 Inter Group Comparison of Mean Difference of Tooth Movement between Groups In Relation To Different Time Points

Time Intervals	PRF Group	MOP Group	P-value
Baseline-5 Weeks	1.452±0.56	1.352±0.55	0.666
5 Weeks-12 Weeks	1.305±0.34	1.213±0.42	0.562

P<0.05 is Considered as Statistically Significant

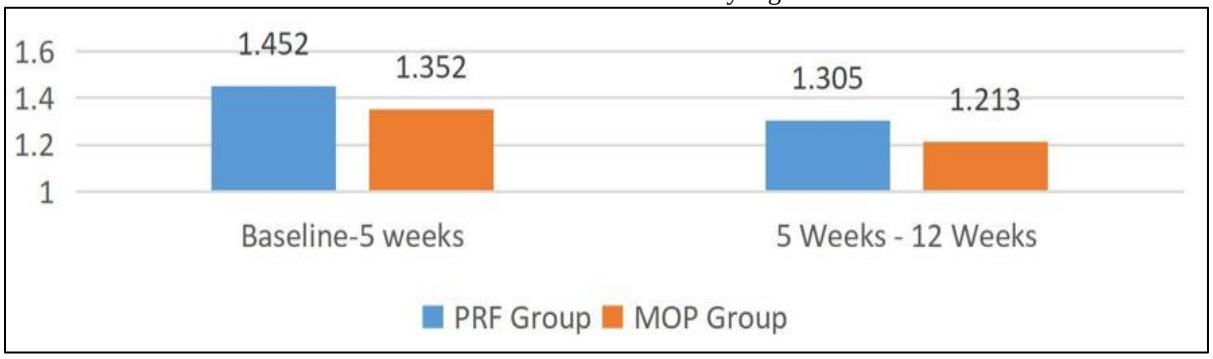

Fig 5 Comparison of Mean Difference of Tooth Movement between Groups in Reation to Different Time Points

Table no. 8 describes the overall mean rate of space closure observed between the groups before and after the study period. This table clearly indicates that the mean rate of space closure seen between groups did not have a statistically significant difference although the marginally higher space closure seen among PRF group than in the MOP group. The same observation has been represented graphically in fig 6...

Table 8 Inter Group Comparison of Rate of Space Closure between Groups Using Unpaired T Test

Parameter	PRF Group	MOP Group	P-value
Rate of Space closure	2.75± 0.53	2.58±0.64	0.469

P<0.05 is Considered as Statistically Significant

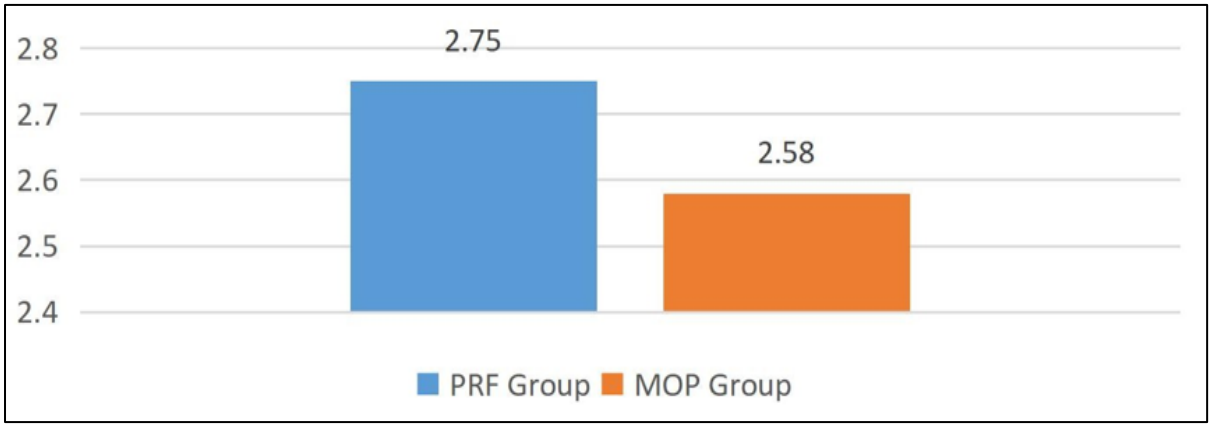

Fig 6 Comparison of Rate of Space Closure between Group before and After the Study

VII. DISCUSSION

A randomized controlled trial was carried out in the Department of Orthodontics involving patients aged 18 to 25 years who were undergoing orthodontic treatment. The study aimed to compare the effects of injectable platelet-rich fibrin (i-PRF) and micro-osteoperforation (MOP) on the en-masse retraction of maxillary anterior teeth. The average age of participants in the i-PRF group was 20.91 ± 2.53 years, while it was 22.33 ± 1.55 years in the MOP group. The i-PRF group had a higher number of female participants, whereas the MOP group included an equal number of male and female subjects.

Orthodontic treatments typically require a lengthy commitment, often lasting between 18 and 24 months. Various factors—including the type and severity of the malocclusion, chosen treatment approach, patient's age, and level of compliance—can further extend the duration. Prolonged treatment increases the risk of complications such as gum issues, inadequate oral hygiene, white spot lesions,

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root shortening, and in some cases, tooth loss.[1,8,9] In addition, the primary challenge in achieving orthodontic tooth movement lies in the biological reactions of the periodontal structures and surrounding bone tissue.[1] Numerous experimental and clinical studies have explored ways to speed up tooth movement by modifying the tissue's biological response through surgical procedures, medications, physical techniques, and other approaches.[8,10-14] Nevertheless, none of the techniques are routinely used in orthodontic practice.

Platelet-rich fibrin (PRF) was first described by Dr. Joseph Choukroun and associates in 2001. It is a second-generation platelet concentrate that is created from the patient's

Blood without the need of biochemical changes or anticoagulants. PRF increases healing on its own or in conjunction with a bone substitute by producing both soft and hard tissues.[15] Applying i-PRF is a simple, repeatable, autogenous, minimally intrusive, inexpensive, and complication-free process.[1]

In 1983, H.M. Frost introduced the concept of the "regional acceleratory phenomenon" (RAP), highlighting that a localized reduction in bone density—osteopenia—can occur without an overall loss in bone volume. This temporary decrease in density facilitates faster movement of teeth through the jawbone. Frost proposed that when a tissue is healing and receives a targeted

Stimulus, such as minor cortical bone perforations, it responds by accelerating the repair process compared to normal healing.[16]

Alikhani et al.[17], in an animal study, found that the speed of tooth movement was significantly higher in the group that received micro-osteoperforations, showing movement nearly twice as fast as the group treated with orthodontic force alone. This accelerated movement was linked to a marked increase in cytokine expression observed 24 hours after applying force in the micro-osteoperforation group compared to the control group.

Research on micro-osteoperforation in humans[17,18,19,21] has primarily examined its impact on canine retraction, while animal studies[20,22,23] have looked into its influence on forward movement of molars. A recent clinical trial in humans assessed how micro-osteoperforations affect the rate of space closure during en masse retraction. Given the ongoing interest in minimally invasive techniques to potentially enhance tooth movement, well-designed randomized controlled trials targeting various dentoalveolar areas would be highly valuable.

Our study compared the effect of i-PRF and MOP on the rate of space closure during enmasse retraction of maxillary anterior teeth. In the present study, a total number of twenty four subjects who met the inclusion criteria were recruited, randomized and distributed into two groups (either i-PRF or MOP), of 12 subjects each. i-PRF consisted of eight females, four males and MOP group consisted of six females and males, totaling 12 participants in each group. Overall, there were 24 participants. A Mann-Whitney test indicated a p-value of 0.678%, suggesting no significant difference in gender distribution between the groups.

The age of the patient also significantly affects the rate of orthodontic tooth movement (OTM). This is mainly due to differences in bone density or the rate of osteoclast recruitment/activation at different ages. Only subjects between the ages of 18 and 25 were included in this study to exclude the effect of age on the rate of orthodontic tooth movement.

The i-PRF group received i- PRF in distobuccal and distolingual side of maxillary canine on both right and left side and MOP group received micro-osteoperforations on both right and left side of maxillary arch.

The results obtained here shows that at the time interval of T0-T2 that is from baseline to 5 weeks, the amount of mean tooth movement/space closure seen is slightly higher among PRF group in comparison to MOP group but this difference is not statistically significant. Following on the with the same groups it was seen that at time interval of T2-T4 that is from 5 weeks to 12 weeks time interval, again the amount of tooth movement seen was higher in PRF group as compared to MOP group and again here the difference seen between groups was not found to be statistically significant. Even though overall tooth movement is more in i-PRF group with rate of 2.75than in MOP group with 2.58 , but the difference was not statistically significant. The present study concluded that the mean rate of space closure seen between groups had no statistically significant difference with the slight higher space closure seen among the PRF group than MOP group.

To further understand the difference between i-PRF and MOP group in rate of tooth movement it is advised that future research should be employed.

VIII. CONCLUSION

The result showed Injectable platelet fibrin increased the rate of space closure during en-masse retraction of maxillary anterior teeth on average of 1.06 fold in i-PRF group when compared with M O P The mean rate of tooth movement per month in the i- PRF group was 0.91mm ,whereas in the MOPl group, the mean rate of tooth movement was 0.86mm.

No statistically significant difference was found in the rate of space closure in the injectable platelet rich fibrin in comparision with the Microosteoperforation group.

This suggests that both injectable platelet rich fibrin and MOP minimally invasive procedure had similar rate of tooth movement which could be an effective enhancing orthodontic treatment efficiency by accelerating tooth movemen

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➢ *Annexure*

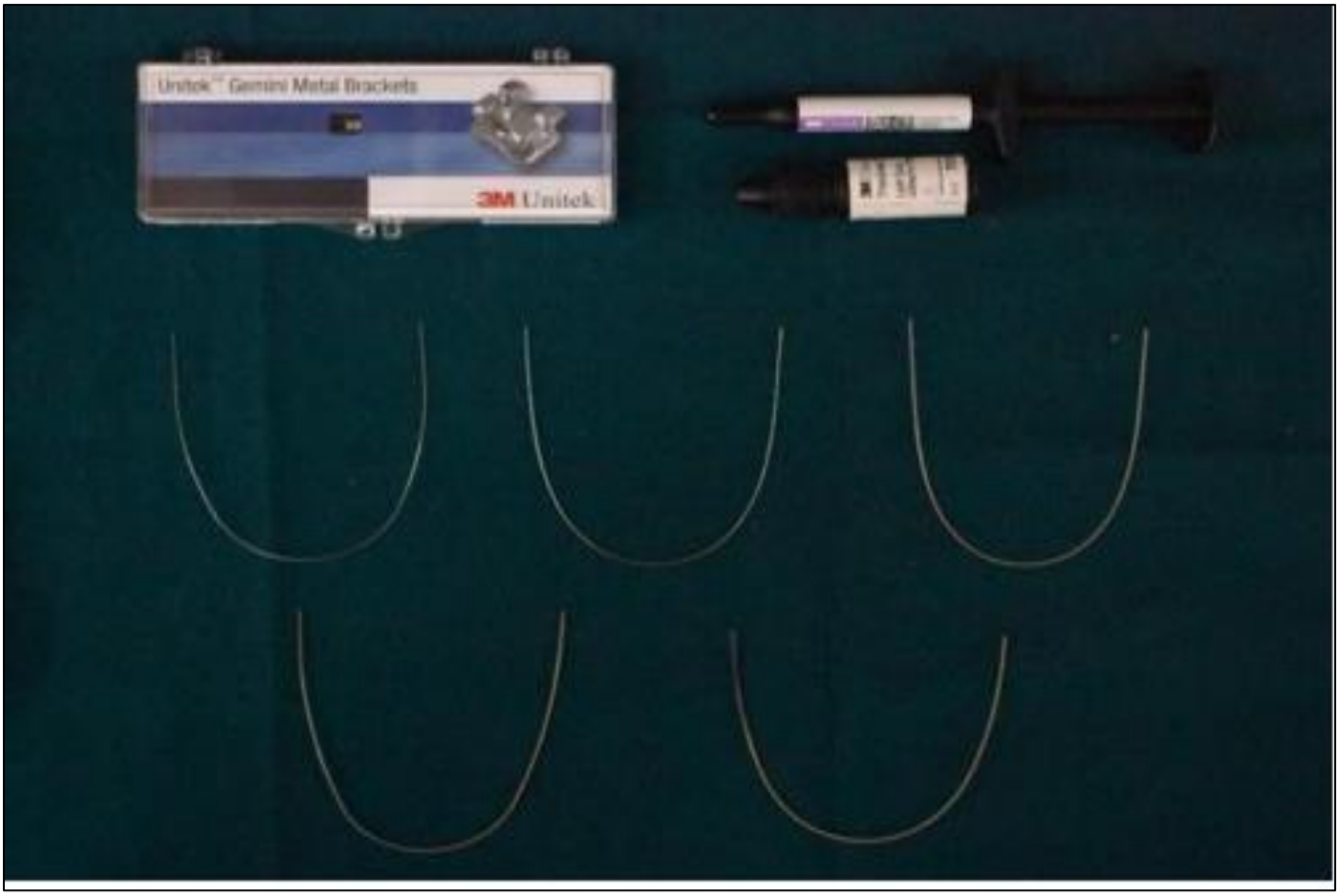

Fig 7 MBT Bracket (3M Unitek Grmini Metal

Fig 8 Alginate Impression Material (Zhermack Tropicalgin) Brackets), Bonding Material

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Fig 9 Digital Vernier Caliper

Fig 10 Orthodontic Stone Class III

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Fig 11 Blood Drawn From Brachial Vein by Using

Fig 12 Centrifuge Machine 10ml Syringe

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Fig 13 I-The I-PRF Obtained From the Upper

Fig 14 PRF Injected In the Distobuccal Periodontal Liquid Layer
Ligament Space of the Right Maxillary Canine

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Fig 15 PRF Injected In the Distolingual Periodontal

Fig 16Armamentarium for Micro-Ligament Space of the Right Maxillary Canine Osteoperforation

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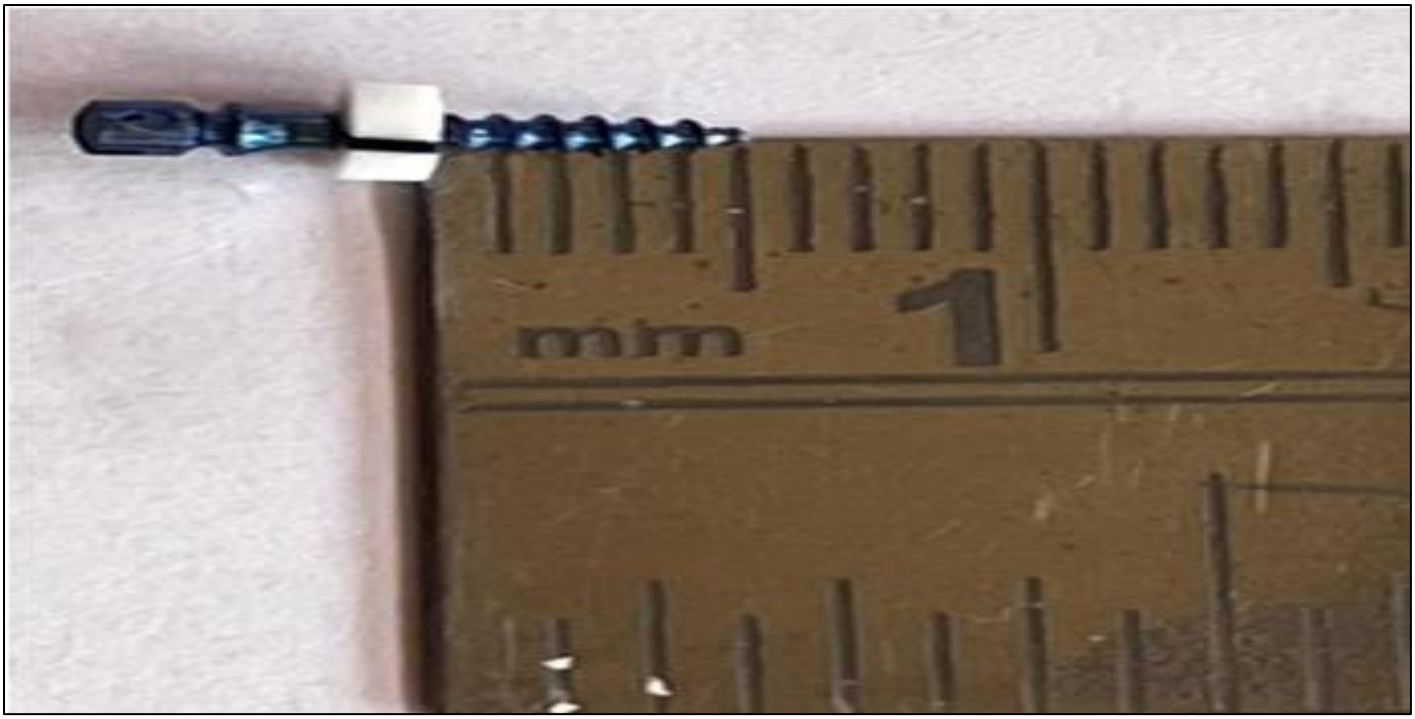

Fig 17 The Depth of 5mm for Performing depth of 5mm, as measured using a stopper.

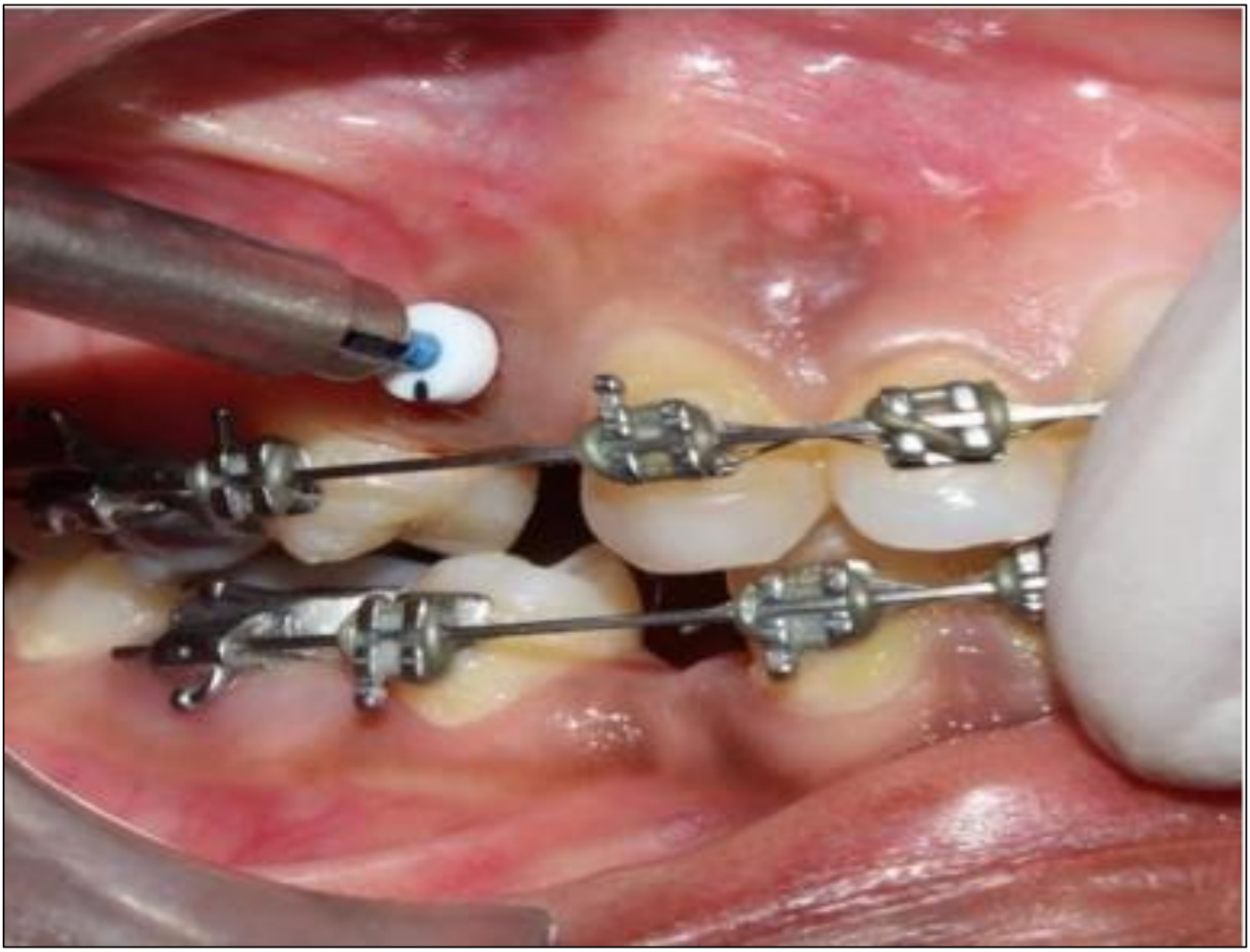

Fig 18 Micro-Osteoperforation Performed to A Micro-Osteoperforations Was Measured Using A Rubber Stopper.

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Fig 19 Retraction Done Using Niti Closed Coil

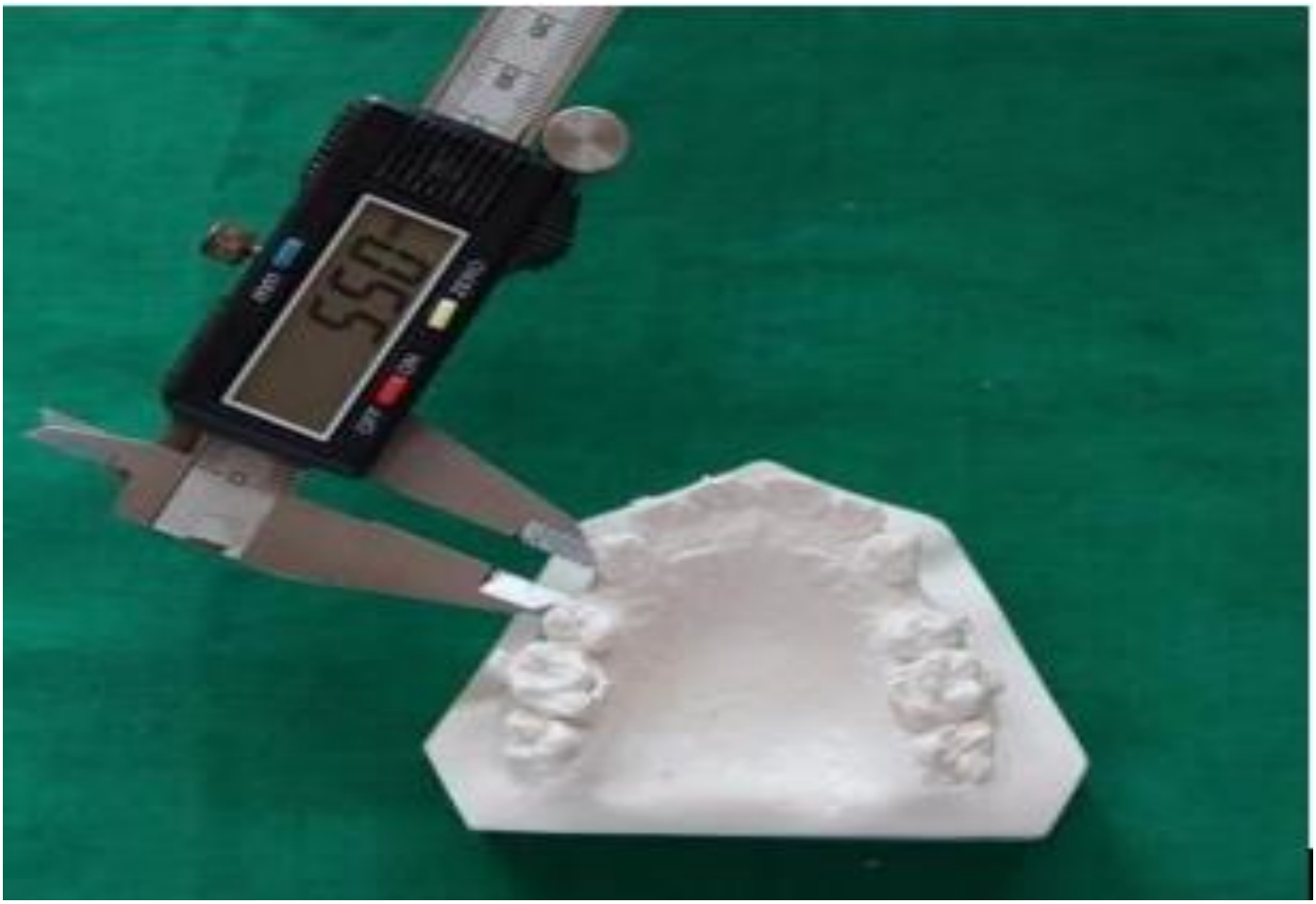

Fig 20 Measurement on Study Model Spring on Right Side

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