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EVALUATION OF THE EFFECT OF PLATELET RICH PLASMA VERSUS PLATELET RICH FIBRIN ON THE RATE OF TOOTH MOVEMENT DURING ALIGNMENT OF MANDIBULAR ANTERIOR CROWDING

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ABSTRACT

Aim: To evaluate the efficiency of Platelet Rich Plasma vs. Platelet Rich Fibrin on overall leveling and alignment time of mandibular anterior crowding.

Subjects and methods: Thirty-six females (18-25 years) with mandibular anterior crowding were randomly allocated into PRP, PRF, or control groups. The first molars on the right and left sides of the mandible were banded or bonded with Roth prescription tube. Mandibular teeth Second premolar to the second premolar were bonded using 0.022-inch pre-adjusted edgewise mini diamond brackets with Roth prescription. Immediately after bonding of the brackets, the initial wire used, the wire sequence was 0.014 Cu-Ni followed by 0.016 Cu-Ni and finally 16x22 NiTi. Our cut-off was17x25 Stainless Steel wire. In PRP or PRF group, the patients were injected into the mandibular anterior segment on the first day of fixed appliance insertion. Over the period of seven days following the initial archwire insertion, visual analogue scale questionnaires were completed by each patient. The irregularity index was monitored using digital models.

Results: The average alignment time was considerably shorter in the PRP and PRF groups compared to the control group (60±15, 64.29±26.99 and 126.43±51.86 days respectively). The PRP and PRF group displayed a significantly higher mean alignment improvement percentage as well as lower pain scores compared to the control group.

Conclusions: PRP and PRF have the ability to accelerate the alignment of the anterior segment and decrease the discomfort produced by the first insertion of the arch wires.

KEYWORDS: Acceleration; PRP; PRF; Alignment.

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INTRODUCTION

The normal range of orthodontic treatment is 18 to 24 months.Therefore, orthodontic therapy is frequently referred to as a drawn-out process.[1]

Long-term orthodontic treatment has various drawbacks, including a greater risk of tooth decay. Root resorption, gingival recession, irreversible enamel destruction, white spot lesions, in addition to the psychosocial effects on the patients and decreased patient compliance.

Therefore, techniques for speeding orthodontic tooth movement (OTM) are designed to cut the length of the therapy and reduce these side effects. Researchers have looked into the viability of moving a tooth more rapidly than is possible with traditional techniques. Most efforts to accelerate tooth movement can be broadly grouped under surgical techniques such osteotomies, corticotomies, dentoalveolar distractions, piezocisions, and micro-osteoperforations, as well as non-surgical procedures. Non-surgical techniques can be divided into two main categories: biologic and physical. The former uses microvibrations, low intensity laser, photobiomodulation, electromagnetic fields, and direct electrical currents, while the latter uses drugs like vitamin D, prostaglandins, cytokines, and parathyroid hormone locally or systemically.

Injections of platelet-rich plasma and platelet-rich fibrin, which have been developed as noninvasive alternatives to local agents that accelerate tooth movement without causing alveolar bone loss, have a RAP-like effect that encourages the regeneration of alveolar bone[2 3]. Therefore, the idea of this study was aroused to study the effect of Platelet-rich plasma (PRP) and Platelet- rich fibrin injection on the rate of tooth movement during alignment of mandibular anterior crowding.

AIM OF THE STUDY

The aim of this study is to evaluate the efficiency of Platelet Rich Plasma and Platelet Rich Fibrin on the rate of tooth movement during alignment of mandibular anterior crowding.

SUBJECTS AND METHODS

This study was a randomized clinical trial. The CONSORT flow-chart (Figure:1) summarizes the process of enrolment, allocation, follow up and analysis of the recruited sample. This study was approved by the research ethical committee, Faculty of Dentistry Ain Shams University.

At the outpatient clinic of the Orthodontic Department, Faculty of Dentistry, Ain-Shams University, fifty patients were screened. Thirty-six participants were recruited according to the eligibility criteria . After a comprehensive description of the study's design and any potential limitations, patients were asked to sign an informed consent form.

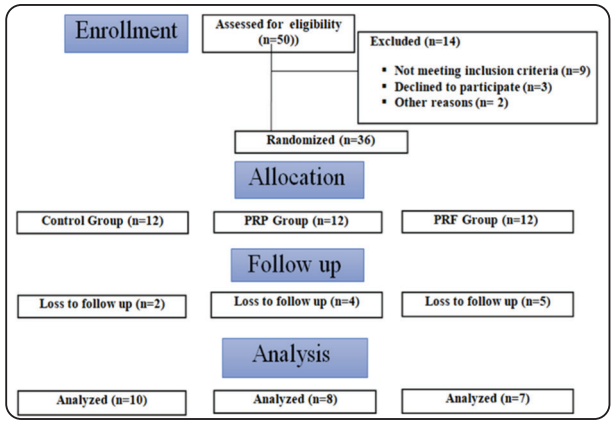

Fig. (1) CONSORT flow- chart

The patients were all adult female patients, ranging in age from 18 to 25. The study only included people who met the following criteria: First molar to first molar permanent dentition, mandibular anterior irregularity index of 4 to 10, angle between lower incisor and mandibular plane of less than 98 degrees, no spaces in the mandibular arch, mandibular anterior irregularity score of 4 to 10. Patients in need of mandibular arch non-extraction orthodontic therapy, patients should be in good health with no systemic disorders or syndromes, and patients with healthy periodontium.

Patients were excluded from the trial if they had a history of any medical issues affecting tooth mobility (osteoporosis, diabetes), primary teeth in the mandibular arch, could not have brackets placed on their mandibular anterior teeth (100% deep bite, blocked or significantly rotated teeth), or were pregnant.

Interventions

Standard pretreatment records were taken for each patient. The first molars on the right and left sides of the mandible were banded or bonded with Roth prescription tube (Ormco,Pomona,California,USA)

Mandibular teeth Second premolar to second premolar were bonded using 0.022-inch pre-adjusted edgewise mini diamond brackets with Roth prescription. Immediately after bonding of the brackets, the initial wire used, the wire sequence was 0.014 Cu-Ni followed by 0.016 Cu-Ni and finally 16x22 NiTi. Our cut off was after 100% of alignment where 17x25 Stainless Steel wire.

PRP group preparation

Using 10 ml syringes, each containing 3 ml of 10% sodium citrate solution as an anticoagulant, 60 ml of whole blood from each patient's medial cubital vein were collected. after it had been spun for 12 minutes at 1000 rpm at room temperature using an 80-1 Electric Centrifuge, RBCs separated at the bottom, platelets, buffy coat in the center, and platelet poor plasma (PPP) at the top of the blood .

The residual buffy coat and PPP were collected and centrifuged once more at a speed of 3000 rpm for 8 min after the RBCs had been removed, after the second centrifugation, the PPP was removed until only 4 ml remained in the test tube and then the remaining PPP was mixed with the buffy coat to become PRP .

PRP must be injected quickly after being prepared since it contains anticoagulant, a significant amount of platelets, and a little amount of RBCs and WBCs.

A thin needle (insuline syringe) was then used to inject the preparation into the labial and lingual sides of the lower four anterior teeth as there were the target sites of injection, 0.7ml with 45 injected angle were inject into the oral mucosa through the attached gingivae and intraligamentary by bending the syringe needle.

PRF group preparation

Using 10-mL injection syringe to draw 10 mL of venous blood from each patient, which was then immediately centrifuged at 700 rpm for 3 minutes at room temperature. All of the lower incisors' attached gingiva on the labial and lingual sides and intraligamentary received an injection of approximately 4ml of i-PRF, which was taken from the top liquid layer. (Figure 2)

This procedure was done on the same day of fixed appliance insertion and wire sequence used in the same as the one used for the control group.

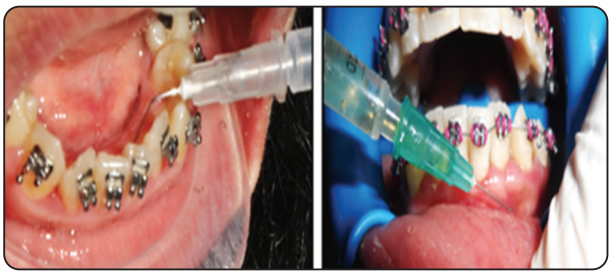

Fig. (2) Injection at the labial and lingual side

Measurements

A 3Shape R-750 desktop scanner (3Shape, Copenhagen, Denmark) was utilised to digitise stone models made from alginate impressions for each subject. The digital models were then used to calculate the irregularity index (LII) using 3Shape Ortho-Analyzer software (3Shape). With the help of the digital calliper function tool, linear measurements were taken to determine LII, which represented the severity of the malalignment[4] (Figure 3) The same operator evaluated the digital model

measurements, on all the casts for 10 randomly chosen patients 4 weeks after initial measurement to assess measurement reliability.

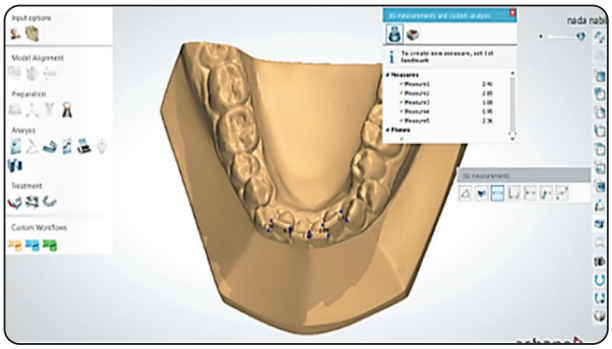

Fig. (3) Using linear measurement

For pain assessment in the first week after the initial arch wire, the patients were told to keep track of their pain levels. They were also questioned if they had taken any pain killers, how easy and satisfied they were with the operation, and if they would do it again, as well as whether or not they would suggest it to a friend .All of the individuals were given a 10-point Visual Analog Scale (VAS)) was used to measure the degree of pain , ease, and satisfaction of all the subjects, with anchors at each end of the line that read "no pain" (0) and "worst pain possible" (10).

Sample Size Calculation

Sample size was determined using El-Timamy et al. [5] earlier study as a guide. This study determined that the minimum acceptable sample size for each subject group was 7, using the PS Power software,when the response within each subject group was normally distributed with standard deviation 0.63, the true mean difference was 1.23, when the power was 80% & type I error probability was 0.05 by using PS power soft ware.

Patients were divided randomly between groups in the current study after being chosen based on the previously specified criteria.

Randomization and Blinding

Simple randomization was used to allocate patients who met the inclusion criteria and gave their consent to participate in the trial to either the control group, (PRP) group or (PRF) group by using the "Microsoft excel" tool, a coworker who was not participating in the clinical experiment constructed randomization sequences. In the order in which they arrived for diagnosis, each subject was assigned a number. Matching that number with the generated sequence was used to assign the individuals to either control or (PRP) or (PRF) group. The investigator was not engaged in the patient assignment in this trial.

Statistical Analysis

Software from the Statistical Package for Social Science (SPSS) version (26) was used for data entry and statistical analysis. Coding and data entry stages both received quality control. Variables are presented as mean and standard deviation. Cronbach' Alpha reliability revealed high reliability for the Little's Irregularity Index α=.945, and good level reliability for the visual analogue pain scale α=.741. As the main outcome was the time at which the Little's Irregularity Index reaches zero (finished alignment), therefor, Cox regression analysis with plot was done. At each point of time which event occurred, One Way ANOVA test was done to find out the significance between the three group. Statistical significance was set at P-value <0.05 and confidence interval of (95%). ANOVA test also used for pain analysis.

RESULTS

Mean±SD of the Irregularity Index had no significant difference (P>0.05) between all studied groups (Control, PRP & PRF) before starting the treatment (Baseline) as shown in **Table 1** ,that indicates all the patients had the same selection criteria and characteristics at the baseline without statistical bias.

TABLE (1) Mean and Std. Deviation of the little's irregularity index before treatment in Control (GI), PRP (GII) and PRF (GIII) using One Way ANOVA test.

Intervention group	Little's irregularity index ttt		P
	Mean	Std. Deviation	
Control (GI)	2.5459	0.9622	
PRP (GII)	0.8613	0.3255	.804
PRF (GIII)	0.6410	0.2423	

Improvement rate Mean & SD % of little's irregularity index between groups during alignment.

Table 2 reveal overall improvement occurred in the little's irregularity index of both finished and unfinished tooth alignment of each patient between groups. So, **after 14 days till 2.5 months** of tooth alignment the PRP group recorded the highest improvement rate 100% followed by PRF group 95.7±11.4%, with insignificant difference between them. While control group recorded Lowest improvement rate 76.2±20.9% with Significant deference between control group and both PRF and PRP group P<0.05. **Then after 2.5 months till 6th month** of tooth alignment, the PRP and PRF improvement rate reach 100% after 2.5 months and 4th month respectively, till 6th month of alignment with insignificant difference between them. While control group recorded 98%±2.6% with significant difference between control group and both PRP and PRF group.

Alignment rate Mean & SD % of little's irregularity index between groups after each completed alignment.

Cox Regression test used to identify the time at which one or more patient finished the treatment (little's irregularity index= 0) as shown in (figure 4) which demonstrates the main six intervals (1.5m, 2m, 2.5m, 3m, 3.5m & 4m) at which the little's irregularity index become zero.

TABLE (2) Improvement Mean and Std. Deviation % of the little's irregularity index After 14 days till the 6th month of treatment in the Control (G1), PRP (GII) and PRF (GIII) using One Way ANOVA test.

Examination Time	Control (G1)		PRP (GII)		PRF (GIII)		P
	Mean	SD	Mean	SD	Mean	SD	
After 14 Days	27.9	17.4	21.5	10.9	22.7	13.4	0.67
1st Month	41.0	20.5	51.0	9.1	45.8	13.0	0.47
1.5 Month	57.5	21.9	81.8	18.8	77.0	22.4	0.10
2nd Month	69.4	22.1	88.6	15.2	88.5	20.0	0.13
2.5 Month	76.2	20.9	100	0	95.7	11.4	0.01*
3rd Month	84.1	20.6	100	0	96.2	9.9	0.09
3.5 Month	89.7	17.9	100	0	97.2	7.5	0.23
4th Month	92.7	15.5	100	0	100	0	0.24
4.5 Month	93.5	13.2	100	0	100	0	0.22
5th Month	95.3	8.8	100	0	100	0	0.16
5.5 Month	96.5	5.5	100	0	100	0	0.09
6th Month	98.0	2.6	100	0	100	0	0.02*

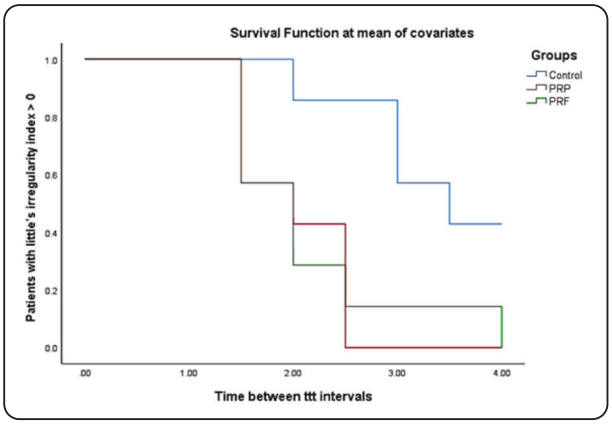

Fig. (4) Cox regression test reveal the finished alignment time (little's irregularity index=0) of patents in each studied group.

Final summary of both Little's irregularity index and Pain index:

From the previous analysis that shown above we can easily assume that PRP treated patient complete 100% of their alignment within 2.5 months with 40% improvement rate per month with 31.1% less pain experience than those treated in controlled group with significant difference between PRP and Controlled group P<0.05. PRF treated patient also show much more similar results to PRP group with 85.71% completion of their alignment within the same period with 25% improvement rate per month and 20.5% less pain experience than controlled group with significant difference between PRF and PRP P<0.05.

TABLE (3) Final summary of both Little's irregularity index and Pain index between all groups.

	Little's irregularity index			**Pain index**
	Complete alignment rate %	**Improvement rate %**		**pain %**
	Time elapsed till 100%	Highest rate	Rate per month	
PRP (GII)	2.5 months	100%	40%	68.85%
PRF (GIII)	4 months	100%	25%	79.42%
Control (GI)	> 6 months	98%	< 16.3%	100%

DISCUSSION

One of the main objectives for orthodontists is always to accelerate tooth movement during orthodontic treatment and shorten the overall length of the procedure. In this study the overall alignment time for PRP group takes 60±15 days to reach the maximum improvement possible followed by PRF group 64.29±26.99 days. While control group takes 126.43±51.86 days with significant difference between them P<0.01, therefor PRP injection reduced the total alignment time by 52.55% and PRF by 49.15%. This confirms that our method of acceleration of OTM in the lower incisors crowding model using PRP and PRF is efficient and comparable to other established methods of acceleration as these findings were consistent with Abdel Ghaffar et al [6]who's study conducted that LLL therapy can reduce total alignment time by 40%.

The method of acceleration used in our study and the results obtained are in agreement with Eric J. W. Liou [7] who found that PRP injection can accelerate alignment 1.7 folds in average , and also in agreement with Pranshu Mathur[8] who reported effective acceleration of PRP in the first 21 days of initial alignment .Moreover El-Timamy et al[5] study also found faster rate of OTM in injection sites by PRP during the first 2 months of tooth movement.

However, this is in disagreement with Liu et al[9] who proved the short acting effect of PRP on accelerating tooth movement. He reported the faster changes occurred only during the 1st month. Following cessation of PRP injections, the rate of canine retraction on the intervention side was initially slower than and then similar to that on the control side, and conclude that PRP could accelerate orthodontic tooth movement in the short term with no prolonged effects.

To our knowledge, no other study tested PRF in lower anterior alignment. However other studies tested PRF on other models such as canine retraction.

Our study reported that changes in little' Irregularity Index in sites injected by PRF, when compared to control, were statistically significantly. This is in agreement with Erdur et al[10] who performed a randomized study over 20 patients comparing PRF to control group and he found that the rate of canine tooth movement was higher in the study group than the control group at all time.

In this study, the only intervals that show significant increase in rate alignment of Little's irregularity index was 2.5 months, 3rd month and 4th month where PRP achieve 100% of patient total

alignment objective after 2.5 month followed by PRF 85.71% from 2.5 to 3 months and then 100% at the 4th month of treatment. Regarding control groups 14.29% followed by 42.86% and finally 57.14% respectively with statistically significant difference between Control group and both PRP and PRF groups $P<0.05$, and insignificant difference between PRP and PRF $P>0.05$.

CONCLUSION

1. PRP and PRF were efficient in accelerating tooth movement by reducing total alignment time by 52% and 49% respectively.
2. PRF has the advantages on PRP of being greater production simplicity, no blood manipulation, no need for additives, PRF produces a larger percentage of blood product than is taken, more healing factors and more stem cells with less trauma.
3. Participants who had PRP or PRF injections experienced only mild discomfort following the procedure.
4. There were no harmful side effects recorded.

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