Evaluation of the Efficacy of Injection Platelet-Rich fibrin (I-PRF) in Accelerate Alignment and Levelling in an Adult Sample

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ABSTRACT

Introduction: The long duration of orthodontic treatment is one of the factors that reduce the desire of patients to undergo orthodontic treatment. Many methods have been devised to accelerate the orthodontic movement, but they are not without their negative effects. The injection of platelet-rich fibrin (I-PRF) is one of the modern methods, whose role is still unknown in accelerating dental movement and reduction in the duration of orthodontic treatment. This study aims to evaluate the effectiveness of injection I-PRF to accelerate alignment and levelling of the upper anterior teeth and reduce the time required for treatment.

Material and Methods: The sample consisted of 16 patients (10 females, 6 males) in need of orthodontic treatment and who have crowding at the level of the upper anterior teeth. Patients were divided into two 2 groups: the experimental group would be injected with platelet-rich fibrin (I-PRF) and a control group for which only brackets would be applied. The treatment progress was evaluated at 3-time stages, and the studied variables were the rate of improvement in alignment and levelling and the time taken to complete the treatment.

Results: The results of the study showed that platelet-rich fibrin injection I-PRF was ineffective in accelerating the alignment and the levelling process ($P > 0.05$) as well as in reducing the time required for treatment ($P > 0.05$).

Conclusion: Injection platelet-rich fibrin I-PRF is ineffective in accelerating orthodontic movement.

Key Words: Accelerate, Alignment and levelling, Injection Platelet-Rich Fibrin, Orthodontic Treatment, Dental Movement, Duration

INTRODUCTION

The question that worries orthodontic patients is what is the period that we need to complete the orthodontic treatment completely, as the period of orthodontic treatment may reach about 24 months in some cases, especially severe ones, in addition to the cosmetic problems that the patient may complain about which are related to the appearance of brackets on the teeth.^{1,2}

The presence of brackets on the teeth for a long period may cause many problems, including periodontal issues, dental caries, root absorption and this is due to the length of time for treatment.³

The stage of alignment and levelling is one of the first and most important therapeutic steps. Through this step,

incisal edges, and posterior teeth cusps are placed on one level to achieve perfect points of contact between the teeth.^{4,5}

In some cases of malocclusion, especially severe ones, this stage may take about 8 months. Therefore,⁶ the interest in orthodontics has increased in finding new methods and techniques to accelerate treatment.⁷ Various methods and techniques have been used to accelerate orthodontic treatment,⁸ this includes biomaterial injection and surgical and physical methods.⁹ Yet, despite the effectiveness of some of these methods in accelerating dental movement, each of them has its disadvantages and side effects on the patient. Therefore, attention must be paid to another effective safe and simple non-traumatic method hence the idea of using platelet-Rich fibrin was originated.

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Platelet-rich fibrin is a therapeutic approach and it is a new generation of platelet concentrates.¹⁰It was introduced to the domain of dentistry by Choukroun et al. in 2001 who developed this treatment technique.¹¹

Platelet-rich fibrin injection technology (I-PRF), which is obtained in liquid form for injection.^{12,13} has been developed through the concept of reduced speed centrifugation.¹⁴

PRF is a biomaterial.¹⁰Autologous is taken from a person's blood.¹⁵Unlike PRP, no external bio-actives are added to the active platelet. Rather, the blood sample remains normal.¹⁶ The importance and therapeutic benefits of platelet-rich fibrin come through the presence of key and other common elements that collectively contribute to the healing processes and regeneration of the soft and bone tissues represented by the presence of fibrin in the form of a matrix with large and significant numbers of leukocytes, cytokines, platelets.¹⁷, in addition to the participation of growth factors which play an important role in the processes of healing.¹⁸

Platelet-rich fibrin is a simple, easy-to-apply and economical technique that does not require adding any substances to the blood sample as an anticoagulant.¹⁹

There are no studies on the role that platelet-rich fibrin injection can play in accelerating aligning and levelling the upper anterior teeth and reducing the time required for treatments.

Therefore study aims to verify the effectiveness of injection I-PRF to accelerate alignment and levelling of the upper anterior teeth and reduce the time required for treatment.

MATERIAL AND METHOD

Study Design and Population

A randomized controlled clinical study, two parallel groups design.

Ethical approval was obtained through a research board resolution (NO2315 Date 31/7/2019).

The research sample consisted of 16 patients (10 females, 6 males) from the patients reviewing Orthodontics Department, Faculty of Dentistry, Tishreen University, Lattakia, Syria between 2019 and 2021. These patients needed alignment and levelling of upper anterior teeth. The sample size was determined using G*Power 3.1.9.7 (Universität, Dusseldorf, Germany) program through conducting a pilot study of the experimental sample where the values of the arithmetic averages of the Little index values were calculated before the alignment process in (mm) in the 2 groups (Mean: 5.83, 4.88). The value of the standard deviation (SD: 0.37, 0.71) was the effect size (1.68) at an (α) error prob 0.05%.

They were admitted according to the following inclusion criteria; the age of patients ranges between 16-24 years, medium crowding between 3-6 mm in the area of the upper anterior teeth according to the Little irregularity index.²⁰, class I according to angel classification. Exclusion criteria include the presence of any systemic disease that affects the orthodontic movement, a patient undergoing previous orthodontic treatment, a patient who takes medicines that affects dental movement, and the presence of bleeding disorders.

The method and goals of the treatment were explained to the patients and informed consent was obtained from each patient to accept the procedures applied in the research

Patients were randomly assigned to 2 groups with an Allocation ratio (1:1) using the sample randomization principle. Each group included 8 patients (8 control groups applying brackets only) (8 group injection I-PRF with brackets).

The diagnosis was made based on (cephalometric, panoramic radiographic and gypsum modules) which the value of the little irregularity index was accurately calculated and that was taken for each patient before the orthodontic treatment was applied

Clinical Stage

All patients underwent a standardized fixed orthodontic treatment according to the following criteria: meta brackets were applied with a slot of 0.022 prescription MBT from (USA, Ortho Technology), the orthodontic bands were affixed to the upper first molar, the brackets were tied with an elastic ligature (American Orthodontics, Sheboygan, WI USA) and the sequencing was done using wires until the end of the alignment and levelling stage (0.14 NITI) (0.16 NITI) (14*25 NITI) (18*25 NITI) (19*25 SS).

Preparation and Injection I-PRF

TD4A centrifuge (Changsha Yingtai. Co., Ltd) was used to obtain I-PRF by drawing a 20ml blood sample with a needle that was placed in dry and sterile plastic tubes (each tube 10 ml) that do not contain any anticoagulant within. The tube was placed within centrifuge and the number and cycles were set at 600 cycles for 8 minutes according to the protocol Ghanaat et al.²¹(Fig.1)

The product obtained consists of 2 layers: on the bottom are red blood cells, on the top layer is yellow platelet- rich fibrin. The amount of I-PRF 4 ml was standardized. (Fig.2)

The patient was asked to rinse with 0.12% Chlorhexidine solution in order to reduce the bacterial presence during the injection I-PRF.

Local anesthesia was used to control pain during the injection I-PRF process in the upper anterior vestibule area using a short

length needle and with 27 gauge and anesthetic. Ampoules lidocaine hcl 2 % - epinephrine 1:80000) (Colombia)

The I-PRF was collected from the plastic tubes using 18 gauge needles. 0.6 ml was injected into each of the six anterior upper teeth into the gingival area attached by using 27 gauge needles. After I-PRF injection, the (0.14 Niti) pre-wire was placed to start the alignment and levelling process. (Fig.3)

Patients were followed up periodically, with an emphasis and adherence to oral care and the need for immediate review in the event that once the bracket fell in order for it to be re- attached directly. The alignment and levelling process is considered completed when the little index, the value becomes less than 1mm and all bracket slots are on the same level.

Alignment and Levelling Measurements

After casting the gypsum models resulting from the prints, Little's index, was measured during the alignment and levelling process through a digital thickness gauge (Digital Caliper, China) placed parallel to the horizon to measure the horizontal distances between the six front upper teeth meeting points during the following four-time stages: (T0: after the start alignment and levelling-T1: after 1 month -T2: after 2 month-T3: after the completion of alignment and levelling). (Fig.4)

Studied Variables:

-alignment and levelling Improvement Percentage (ALIP): Determining the percentage of improvement in alignment and levelling by calculating the value of the change in the Little index in one of the studied periods (T1) or (T2) or (T3) which is calculated by subtracting the value of the Little index at the studied period from the value of the Little index at (T0) When the primary wire is inserted, the value of the little index at (T0) is multiplied by 100 Through the following formula:

$$ALIP = \frac{\text{amount of change in the value of the little index itself}}{\text{the value of the little index when the initial wire is inserted}} \times 100$$

- The overall time required to complete the levelling and alignment was calculated by calculating the number of days between (To) and (T3).

Statistical Analysis

SPSS v. 25 (IBM Corp., Armonk, USA), was used to enter and process data through a set of tests. A set of tests was applied to calculate the mean values, standard deviation, range and a test t- student to compare the averages of the values of the little index values, the percentage of alignment improvement, levelling and alignment speed. The amount of the mean difference was compared at a significant level in which (P-value) less than 0.05 is significant.

RESULTS

The study sample consisted of 16 patients (10 females - 6 males) with an average age of the entire sample (21.9±2.2 years). These patients needed to align and level the upper anterior teeth. The patients were divided into two 2 groups: (I-PRF group and the control group). The variables for each group were studied at the periods and the 2 groups were compared. The statistical results showed that there were no significant differences between the 2 groups.

Alignment and Levelling Improvement Percentage (ALIP)

Applying the T-Student test to correlated samples of small sizes to compare the significance of differences in the average percentage of improvement before and during the successive stages of treatment for both methods shows that there are statistically significant differences in the direction of increasing the percentage of improvement with the progression of the treatment stages. The differences were also significant between all treatment stages (P<0.05) (Table 1).

The T-Student test was applied for small independent samples to compare the differences between the two groups of blockers in the T1 and T2 stages. The results showed that the differences between the averages were not significant at a significance level of 5%, which means that the differences between the effectiveness of the two methods are not significant (P > 0.05). (Table 2)

Overall Alignment and Levelling Time

The mean and the standard deviation related to the time required to finish the alignment and levelling were calculated in the 2 groups, where the mean time duration of the 2 groups was very close to 151.5 days in the platelet-rich fibrin group and 151.63 in the control group, and the longest duration in both groups of brackets was 152 days while The minimum term is 150 days (table 3)

A comparison of the differences between the treatment time between the two groups according to the T-Student test of the independent samples of small size to compare that the differences between the means were not significant (P>0.05). (Table 4)

DISCUSSION

The duration of orthodontic treatment may last about 2 .5 years.²² and this long period of treatment may involve some risks, including mineral dissolution of the enamel, the spread of caries and retraction of the gingival and absorption of the roots of the teeth in addition to the patient's cooperation which may be reduced^{23,24}. Therefore, it has become necessary to

find accelerated techniques of orthodontic treatment to avoid the side effects caused by the long duration of treatment.^{6,25}

Hence, the current research aimed to measure the efficacy of platelet-rich injection in speeding up alignment and levelling and reducing the time required for treatment. The aged sample was 16 and 24 years

Patients of very young and very old ages were excluded to exclude the presence of growth factors and metabolism differences at the level of the alveolar bone.²⁶, which may affect the study of the movement rate of alignment and levelling.

The study sample consisted of 16 patients (10 females, 6 males) to ensure accurate results and avoid any significant changes that might affect the alignment and levelling process, the treatment progress was evaluated every week. The alignment and levelling rate was calculated by applying a Little irregularity index. This index is characterized by being accurate and simple and is suitable for measuring dental crowding in the anterior teeth area.²⁷

The results of the study showed that platelet-rich fibrin injection was ineffective in improving the alignment and levelling ratio and did not shorten the time required for treatment. There are no previous studies that have evaluated the effectiveness of applying platelet-rich fibrin to accelerate alignment and levelling and reduce treatment time. From the results of the study, it can be said that fibrin injection may have increased the spread and differentiation of osteogenesis, and this reduced the rate of alignment and levelling,

This interpretation is consistent with the Xie et al.²⁸ report, in which it was found that the injection of platelet-rich fibrin stimulates the osteogenesis effect, and Wang et al.²⁹ also found that the injection of platelet-rich fibrin significantly increased the diffusion and differentiation of the osteogenesis.

It can also be said that the presence of leukocytes, growth factors and anti-inflammatory cytokines within platelet-rich fibrin may play a role in preventing or mitigating the inflammatory response that occurs as a result of orthodontic dental movement. This may have reduced the rate of alignment and levelling occurring. This interpretation is consistent with the results of both studies by Nasirzade et al.³⁰ and Zhang et al.³¹ where they found that fibrin rich in platelets plays an anti-inflammatory role.

In our current study, we adjust the variables as much as possible by unifying the sequence of wires between the two groups, introducing cases that have convergent congestion at the start of treatment and evaluating the progression of treatment in two weeks to ensure the alignment and levelling process and ensure that no significant changes occur during the treatment stages.

This study is considered the first clinical study to evaluate the effectiveness of platelet-rich fibrin injection is accelerating

alignment and levelling and reducing the time required for treatment. The results showed that injection I-PRF was ineffective in accelerating the rate of alignment and levelling and in reducing the treatment time.

CONCLUSION

In the current study, two groups (an experiment group with platelet-rich fibrin injection (I-PRF) and a control group) were compared to verify the effectiveness of platelet-rich fibrin injection on accelerating alignment and levelling. we concluded that it is an ineffective method in accelerating paving and levelling and therefore did not lead to a reduction in the duration of orthodontic treatment and therefore through this current conclusion it is necessary to carry out future clinical studies to find other effective means to speed up alignment and levelling and thus reduce the duration of orthodontic treatment.

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The authors report no conflict of interest.

Authors' Contribution:

Prof. Dr. Hazem Hassan and Associate Professor. Dr. Fadi Kalil supervised the study and provided valuable advice and consultations.

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Table 1: Comparison between two group I-PRF and control group in the improvement of the alignment and levelling percentage at the 4 stages (To.T1.T2.T3)

Control group			I-PRF			Time
P-value	Z	Mean	P-value	Z	Mean	Results Test of T-Student
0.000*	6.831	45.608	0.000*	8.491	38.338	To - T1
0.000*	12.461	64.21	0.000*	17.25	70.238	To - T2
0.001*	5.186	18.604	0.001*	6.071	31.90	T1 - T2
0.000*	8.147	54.393	0.000*	13.66	61.663	T1 - T3
0.000*	6.945	35.789	0.000*	7.31	29.763	T2 - T3

* statistically significant. $P < 0.05$

Group: I-PRF-injection platelet-rich fibrin

M: Mean

Table 2: Comparison of the differences between the mean percentage of improved alignment and levelling between the two groups I-PRF. control group according to the time treatment stages T1 and T2.

Variable	Period of Comparison	Group	Mean	S D	Mean	Z	P-value
ALIP	T1	I-PRF	51.1	38.338	7.27%	0.902	0.382
		control group	70.9	45.608			
	T2	I-PRF	82.7	70.238	6.02%	0.918	0.374
		control group	80.7	64.211			

$P > 0.05$

Group: I-PRF-injection platelet-rich fibrin

(ALIP): alignment and levelling Improvement Percentage

M: Mean - SD: standard deviation

Table 3: 1 comparison between the two groups (I-PRF. control group) in terms of treatment time

Groups	N	Rang	Min	Max	Mean	SD
I-PRF	8	1	151	152	151.50	0.535
Control group	8	1	151	152	151.63	0.518

Group: I-PRF -injection platelet-rich fibrin

R: Rang- Min: minimum- max: maximum- M: mean- SD: standard deviation

Table 4: Comparison of the difference between the two groups according to treatment time

Variable	Group	Mean	Z	P-value
treatment time	I-PRF Control group	0.125	0.475	0.642

$P > 0.05$ M: Mean

Figure 1: Preparation (I-PRF) A- Draw a sample of the patient's blood's; B- Put blood into the plastic tube;-C Put the tubes within the centrifuge.

Figure 3: After injection (I-PRF).

Figure 2: (I-PRF) liquid D-After centrifuge; E- Liquid collection (I-PRF).

Figure 4: Determine the value of the little index on gypsum Models.