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The impact of platelet rich plasma on upper canine rotation after maxillary teeth en-masse retraction

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Abstract:

Aim: *this study was aiming to evaluate the impact of platelet rich plasma on upper canine rotation after maxillary teeth en-masse retraction.*

Material and Methods: *Twenty patients with age range 18-25 years were enrolled in this randomized controlled clinical trial over a duration of twelve months. They were classified into two groups; Group I: Control, Group II: Platelet rich plasma (PRP) injection. In both groups extraction of the maxillary first premolars and retraction of the maxillary anterior teeth on two self-drilling miniscrews was done. The six anterior teeth were retracted by Niti coil spring on crimpable hooks placed distal to the upper lateral incisors. The rotation of upper canines was measured from digital models.*

Results: *The results showed insignificant difference between the two groups regarding upper right and left canine rotation (P>0.05).*

Conclusion: *The impact of platelet rich plasma injection on upper canine rotation showed no difference after maxillary teeth en-masse retraction.*

Keywords: *En-masse retraction, platelet-rich plasma, canine rotation.*

Introduction:

Orthodontic tooth movement is the result of a biological response to an encroachment in the physiological equilibrium in the dentofacial complex via an externally applied force [1].The long duration of the treatment is usually considered as a disadvantage for some patients, especially adult patients, which could be one of the reasons behind people refraining from orthodontic treatment.

Furthermore, extraction cases usually take a longer duration than non-extraction cases.[2] Several studies compared two-step retraction to the en-masse retraction of the anterior teeth as regards to the amount of anchorage loss in the maxillary posterior teeth and the rate of maxillary anterior teeth retraction [2-6].

Throughout the literature, there have been several reports about both invasive or non-invasive techniques for accelerating tooth movement. Those techniques varied between clinical and experimental methods which all aimed at maneuvering the teeth into a more elastic environment thus increasing the rate of orthodontic tooth movement [7-12].

Unlike the invasive surgical insult, platelet

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rich plasma (PRP) is considered as a less invasive approach. It's concept depends on enhancing bone remodeling relayed on regional acceleratory phenomenon that causes growth factors and cytokines release which in turn activate alveolar bone remodeling [13,14]. locally injected PRP in many animal studies had shown favorable results for orthodontic tooth movement [15-21]. Also PRP achieved positive results in some human studies [22-24].Two- step retraction technique was used in most of these human studies, whereas only a couple of authors evaluated en-masse retraction [25,26] ,but they did not assess the impact of PRP injection on canine rotation . A randomized clinical trial design for finding out the impact of PRP on canine rotation after en-masse retraction is peculiar in our study.

Accordingly**,** this study aimed to assess the impact of platelet rich plasma on upper canine rotation after maxillary teeth en-masse retraction.

Material and Methods:

A) Material:

This study was a two-arm randomized clinical trial, with 1:1 allocation ratio. The patients were selected randomly from the outpatient clinic of the Department of Orthodontics, Faculty of Dentistry, Ain Shams University under ethical approval no: FDASU-REC ID 101801. Before the start of treatment, they all signed a written consent.

The sufficient sample size was calculated to be 20 subjects at 80 % power and 0.5 probability**.** The subjects were males and females with an age range of 18-25 years who had a full set of permanent dentition with upper dentoalveolar protrusion in need of extraction of upper first premolars and retraction of the maxillary anterior teeth with maximum anchorage. The patients had either angle class I or class II molar relation with normal or deep bite. On the other hand, those with severe crowding in the upper anterior segment, anterior open bite or shallow bite, gummy smile>4mm, bad oral hygiene or inadequate endodontic treatment were excluded from the study. Moreover, Patients in need of orthognathic surgery, those who had orthodontic treatment, periodontal disease, bone loss, those with any systemic diseases or pregnant women were also excluded.

The sample was classified randomly into two equal groups using “Microsoft excel” which was done by a participant not involved the research. The groups were:

Group I: En-masse retraction on miniscrews (control).

Group II: En-masse retraction on miniscrews accompanied by PRP injection.

B) Methods:

In both groups, orthodontic records were taken and digital 3D models were obtained pre and post en-masse retraction by scanning the stone casts using 3-Shape R-750 scanner (3shape A/S. Copenhagen, Denmark). Two Hubit self-drilling mini-implants (Hubit Orthodontics, Gyeonggi, South Korea) were inserted buccally in the mucogingival junction between the maxillary second premolar and first molar (right and left- handed screws, 1.6 mm diameter and 8 mm length). Six

millimeter length hooks **(Jiscop, Korea)** were crimped onto 0.017" × 0.025" stainless steel wire distal to the lateral incisors and the six anterior teeth were ligated together [2,6].

En-masse retraction was carried out over a period of 12 months using closed NiTi coil springs (Jiscop, Korea) and a consistent force of 200 gram/side as measured by strain guage (Fig.1)**.**

The follow up of patients was carried out every 4 weeks. At each visit, the appliance was checked to ensure that there were no loose wires or debonded brackets and that there was an adequate mini-implant stability. Oral hygiene instructions were reinforced, a consistent retraction force was ensured and the closed coil spring was changed when necessary (Fig.1) [6]. After retraction, finishing and detailing were carried out.

The upper canine rotation was measured on the digital models using GOM Inspect 2019 software. In addition, changes in the rotation of upper canines were evaluated pre and post en-masse retraction by getting the angle created between the line passing through the mesial and distal contact points of upper right and left canines and the median palatine suture on the digital models (Fig.2) [10].The measurements were compared in each group (intra group) before and after completion of retraction as well as between groups (inter group).

In **Group II**, 0.7ml of PRP were injected labial and palatal to the upper 6 anterior teeth, with a 45 degree injection angle through the attached gingivae as well as intraligamentary [25].

Platelet rich plasma (PRP) preparation:

For each subject, a complete blood picture was done to make sure that the patient had normal platelet count [25]. Then, 30 ml whole blood were collected from the medial cubital vein using 10 ml syringes, each containing 3 ml of 10% sodium citrate solution as an anticoagulant. The whole blood was centrifuged at room temperature for 12 minutes at 1000 rpm by 80-1 Electric Centrifuge. After centrifuge, the test tubes had the RBCs separated at the bottom, buffy coat (platelets) in the center and platelet poor plasma (PPP) on the top. The RBCs were left into Bio-Hazardous Waste, and the rest buffy coat and PPP were taken and centrifuged again under 3000 rpm for 8 min. After the second centrifugation the PPP was discarded until only 4 ml was in the test tube and then the rest PPP was mixed with the buffy coat to become PRP [27].

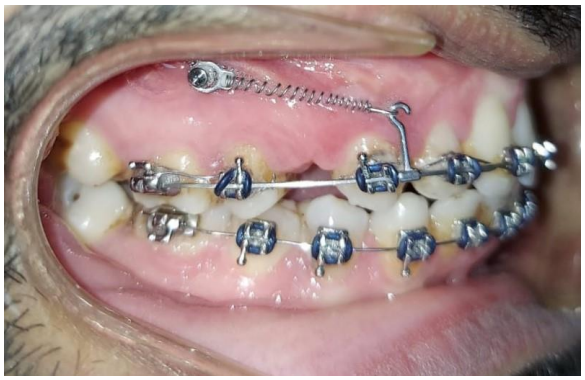

Figure 1: Minicrew in place and Niti coil spring attached to it and the hooks

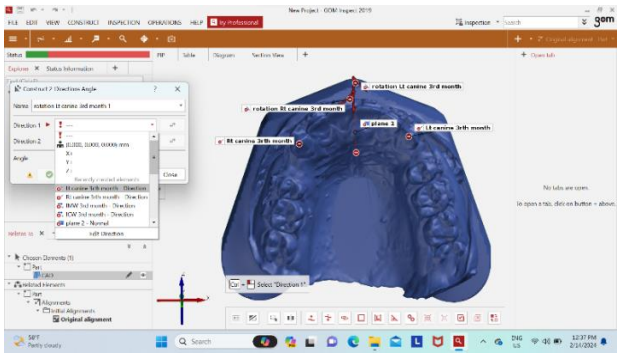

Figure 2: measuring upper right and left canine rotaion on digital model by Gom Inspect 2019 software

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SPSS 20 , Graph Pad Prism and Microsoft Excel 2016 were used for performing the statistical analysis. Shapiro Wilk Normality test and Kolmogorov test presented as means and standard deviation (SD) values were performed to explore normality for all quantitative data. Intra and inter-group comparisons were done. Intra group measurements were parametric so the comparisons between pre and post measurements were done using Paired t test, while comparison between control and treatment groups changes was obtained by using Independent test. However, the Inter group measurements were non-parametric so the comparison between control and treatment groups was done using Mann Whiteney's test. The significance was at P ≤.05.

Results:

Means and standard deviations of digital study model's measurements regarding group I and group II are presented in table (1).

A- Intra group comparison:

1. Group I (Control): Comparison between pre and post measurements in group I revealed insignificant increase as P= 0.86, and 0.59 regarding right and left canine rotation, respectively.

2. Group II (PRP): revealed insignificant increase as P= 0.75, and 0.54 regarding right and left canine rotation, respectively.

B-Intergroup comparison: Mean difference between pre and post measurements and standard deviation regarding digital models' measurements in both groups are presented in table (2). Comparison between both groups carried out by Mann Whiteny`s test, showed insignificant difference between them as P>0.05 regarding all measurements.

Table 1: Means and standard deviations of pre and post digital study model readings in group I and II and comparison between them (Intragroup comparison) using Paired t test

		Pre		Post		Paired Differences					P value Paired T test
									95% CI		
		M	SD	M	SD	MD	SD	SEM	L	U	
Canine rotation	Right	40.39	6.98	41.1	7.56	0.71	12.42	3.93	-9.59	8.17	0.861
	Left	39.47	8.08	37.49	7.73	1.98	11.27	3.56	-6.09	10.04	0.593
Canine rotation	Right	43.55	10.8	41.22	7.99	1.01	9.82	3.1	-6.01	8.03	0.75
	Left	42.54	9.94	43.91	10.23	2.69	13.47	4.26	-12.33	6.95	0.54

M: Mean SD: standard deviation MD: mean difference SEM: standard error mean
L:lower bound U:upper bound CI: confidence interval
P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant

Table 2: Mean difference and standard deviation of difference between pre and post digital study model readings in group I and II, and comparison between them (Intergroup comparison) using Mann Whiteny's test

Name		Group I		Group II		MD	SED	95% CI		P value
		MD	SD	MD	SD			L	U	
Canine rotation	Right	0.92	8.45	1.01	9.82	0.09	4.1	-8.52	8.69	0.98
	Left	3.61	7.28	2.69	13.47	-6.3	4.84	-16.47	3.87	0.21

M: Mean SD: standard deviation MD: mean difference SEM: standard error mean
L:lower bound U:upper bound CI: confidence interval
P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant

Discussion:

Many malocclusions indicate extraction of the upper first premolars, either to relief crowding or to reduce the dentoalveolar protrusion. This either improves facial esthetics or corrects interarch mal-relationships through dental camouflage. The used biomechanical system should achieve adequate retraction of the anterior teeth for proper function, esthetics, and stability within a minimal treatment duration [28]. As orthodontic treatment usually takes around 18-24 months to be completed, this presents a disadvantage to some patients. The expected treatment duration by patients is usually around 6–12 months. Accordingly, many methods have been carried out to accelerate the rate of orthodontic tooth movement.

Multiple techniques of space closure are used in orthodontics [2-6]. Two-step retraction (TSR) (retraction of the canine followed by retraction of all four incisors) and en-masse retraction (ER) (retraction of six anterior teeth at once) are the most frequently used ones. Closing spaces in two-steps might take a longer duration of treatment. Moreover, canines tend to tip and rotate more when the two-step retraction technique is used [29,30]. Trials for accelerating orthodontic tooth movement could be categorized into biological, physical, biomechanical, and surgical approaches.

Several attempts were done to stimulate bone remodeling and decrease bone density during orthodontic tooth movement in order to achieve significant results in a shorter treatment duration and platelet-rich plasma (PRP) is one of the most recently used local means to achieve this [13,14]. However, none of those attempts were done in combination with en-masse retraction of teeth and neither of them evaluated canine rotation that needs to be corrected in the finishing stage which in turn increases the treatment duration. Therefore, the current study aimed to enhance orthodontic movement of teeth and achieve the best treatment outcome through injecting the six anterior teeth with PRP and evaluating it's effect on canine rotation after en-masse retraction.

To our knowledge, no studies evaluated the impact of PRP on rotation of upper canines after en-masse retraction in vivo. Nevertheless, other studies assessed the impact of PRP injection on the rate of en-masse retraction per se [25,26].

The results of this study taken from digital study models, revealed insignificant difference between the right and left canine pre and post en-masse retraction in both groups with p = 0.98 for the upper right canine and p= 0.21 for the upper left canine. These results were similar to **Ziegler and Ingervall** and **Shpack etal** [33,34] who used the same method of canine rotation measurement, but different retraction mechanics and without the PRP injection. On the other hand, the results were in contradiction to **Mezomo et al** [32] who concluded that the upper canines rotation was minimized after retraction, however they were using self- ligating brackets and two step retraction method.

Within the limitation of this RCT, it can be assumed that the injection of PRP despite being less invasive, the results found do not justify

it's clinical use. However, individual steel ligation of canines could be a potential for enhancing the clinical results during en-masse retraction.

Recommendations:

Further studies are recommended to assess the impact of platelet-rich plasma injection on movement of teeth orthodontically with different concentrations as well as injecting a booster dose after 6 months which may exhibit favorable results.

Conclusion:

The impact of platelet rich plasma injection on upper canine rotation showed no difference after maxillary teeth en-masse retraction.

Declaration of conflict of interests:

There was no financial competing interests. This randomized clinical trial was part of a PhD degree in Orthodontics, Faculty of Dentistry, Ain-Shams University. It was self-funded by the principal investigator.

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