Effect of Platelet Based Preparation on Orthodontic Tooth Movement in Rabbits

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Abstract:

Objective: Autologous Platelet rich plasma (PRP) is used to accelerate orthodontic tooth movement, but its effect is still controversial. **Materials and Methods:** Twenty-eight male white Vienna rabbits were divided randomly into two main groups control and PRP. Each group included fourteen rabbits. Tooth movement was measured in seven rabbits from each group after 3 and 14 days respectively. Orthodontic tooth movement was generated by closed coil spring ligated between the mandibular first premolar and mandibular central incisors on both sides. The tooth movement was measured by measuring the space between mandibular first and second premolar using an orthodontic gauge and presented in mm. **Results:** The mean tooth movement after fourteen days in the PRP group was 3.44 mm while mean tooth movement in the control group was 2.53 mm. There was significant difference between PRP group and control group after fourteen days. **Conclusion:** The PRP could be an effective method for orthodontic tooth movement acceleration.

Introduction

One of the main concerns in fixed orthodontic treatment is the relatively prolonged treatment duration due to the remodeling process of the bone.[1] Long treatment duration increases the risk of root resorption, periodontal problems, caries and losing patient compliance.[2] In line with these demands, many approaches have been utilized to accelerate orthodontic tooth movement (OTM) and can be categorized into: surgical methods, physical methods, and injection of biological mediator.[3]

Platelet rich plasma (PRP) is an approach in tissue regeneration. PRP is an autologous concentration of human platelets in a small volume of plasma. It comprises of the concentration of platelets and seven fundamental growth factors. These growth factors are actively secreted by platelets to initiate wound healing and are essential in regulating cellular activities such as mitogenesis, chemotaxis, differentiation and metabolismm.[4]

Materials and Methods:

This study was conducted after approval by the Ethics Committee, Faculty of Dentistry, Mansoura University, Egypt. The study included 28 rabbits divided randomly into two main groups, control group and PRP group. Each group included fourteen rabbits. Orthodontics tooth movement was measured in seven rabbits from each group after 3 and 14 days respectively. Twenty-eight male white New Zealand rabbits were kept in separate cages in a 12-h light/dark environment. They were provided with water and food ad libitum.

The animals were brought a week before starting the experiment to evaluate their general health by daily monitoring the body weight.

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Blood was collected from marginal ear vein of the rabbit with a 25 G needle to collect 5 mm of blood. The blood was collected in a syringe containing 10% sodium citrate which acted as anticoagulant. The blood was subjected to two centrifugations to extract the PRP. The sample was centrifuged at 900 × g for 5 minutes to separate the plasma from hemocytes, then the plasma was centrifuged a second time at 2000 × g for 15 min to separate PRP from platelet-poor plasma.[5]

All procedures were performed under general, anesthesia. The orthodontic appliance was installed by ligating a nickel titanium closed coil spring between the mandibular incisor and mandibular first premolar on both sides. The PRP was injected next to the buccal mucosa of mandibular first premolar.

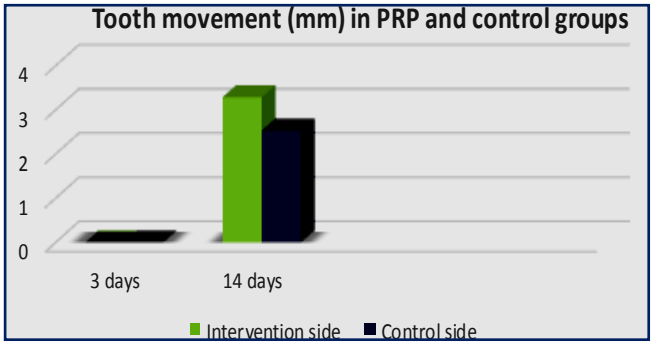
The rabbits were anesthetized and the appliance was removed. The distance between the first premolar and the second premolar on both sides of the lower jaw was measured using digital orthodontic gauge.

Results:

Table (1): Tooth movement (mm) in control group vs. PRP group at each time point:

Time	Intervention group (PRP)	Control group	P value
3 days	0 .17 (0.07)	0.16(0.1)	1.00
14 days	3.44 (0.25)	2.53(0.11)	0.001

Notes: Data are means (standard error of the mean). Test of significance is independent-samples t-test.



Discussion:

This study was conducted mainly to investigate the effectiveness of the injection of autologous PRP on orthodontic tooth movement in rabbits. Male rabbits were used to exclude any hormonal changes of the estrous cycle that might happen to female ones that may affect the bone metabolism and tooth movement. Autologous PRP preparation is considered easy, cheap, fast, and simple as it does not require any special skills. PRP autogenesis makes it free from any transmissible diseases and eliminates immune reaction.[6]

The result of the present study regarding the positive effect of the PRP injection on rate of OTM agreed with Rashid et. al.[7], Gulec et al.[8] Sufarnap et al.[9] and Nakornnoi et al. [10] in their prospective animal studies. The effect of PRP injection also agreed with Khalid[11], and Ali[12] as they showed increased OTM rate in their human clinical trials after using PRP.

In contrast, Akbulut et al.[13] reported no effect of PRP on orthodontic tooth movement in an animal-based study.

Conclusion:

It is suggested that PRP could be an effective method for acceleration of OTM. Further studies are needed to explore the effect of repeated injection.

References:

1. Fink DF, Smith RJ. The duration of orthodontic treatment. Am J Orthod and Dentofacial Orthop. 1992; 102(1):45-51.
2. Huang H, Williams RC, Kyrkanides S. Accelerated orthodontic tooth movement: molecular mechanisms. Am J Orthod Dentofacial Orthop. 2014; 146(5):620-32.
3. Teixeira CC, Khoo E, Alikhani M. Different methods of accelerating tooth movement. In: Clinical Guide to Accelerated Orthodontics: Springer International Publishing Switzerland. 2017; 19-31.
4. Marx RE. Platelet-rich plasma: evidence to support its use. J Oral Maxillofac Surg. 2004; 62(4):489-496.
5. Wang X, Zhang Y, Choukroun J, Ghanaati S, Miron RJ. Effects of an injectable platelet-rich fibrin on osteoblast behavior and bone tissue formation in comparison to platelet-rich plasma. Platelets. 2018; 29(1):48-55.
6. Dhurat R, Sukesh M. Principles and Methods of Preparation of Platelet-Rich Plasma: A Review and Author's Perspective. J Cutan Aesthet Surg. 2014; 7(4):189-197.
7. Rashid A, ElSharaby FA, Nassef EM, Mehanni S, Mostafa YA. Effect of platelet-rich plasma on orthodontic tooth movement in dogs. Orthod Craniofac Res. 2017; 20(2):102-110.
8. Güleç A, Bakkalbaşı BÇ, Cumbul A, Uslu Ü, Alev B, Yarat A. Effects of local platelet-rich plasma injection on the rate of orthodontic tooth movement in a rat model: A histomorphometric study. Am J Orthod Dentofacial Orthop. 2017; 151(1):92-104.
9. Sufarnap E, Sofyanti E, Ilyas S. The Effect of Platelet-Rich Plasma to Orthodontic Tooth Movement. IDCSU 2017-Atlantis Press. 2018;8:80–83.
10. Nakornnoi T, Leethanakul C, Samruajbenjakun B. Effects of Leukocyte- Platelet-Rich Plasma on the Alveolar Bone Changes During Orthodontic Tooth Movement in Rabbits. Korean J Orthod. 2019;49 (6):372–380.
11. Khalid Z. Effect of platelet rich plasma on the rate of orthodontic tooth movement. Dent Health Curr Res. 2019;5:29–35.
12. Ali TM, Chawshli OF. The effect of submucosal injection of Plasma -rich platelets on the rate of orthodontically induced canine retraction in subjects with bimaxillary Protrusion.Suliaimani Dent J.2020;7(2):70-80.
13. Akbulut S, Yagci A, Yay AH, Yalcin B. Experimental investigation of effects of platelet-rich plasma on early phases of orthodontic tooth movement. Am J Orthod Dentofacial Orthop. 2019;155(1):71-79.