

## PRP as a New Effective and Minimally Invasive Accelerated Orthodontic Technique – A Literature Review

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### Abstract

### Review Article

Acceleration of tooth movement is always a concern of both orthodontist and patient. Demand for shorter treatment time with none to minimal side effects is a main request of orthodontic treatment. The submucosal injection of PRP is a clinically feasible and effective technique to accelerate orthodontic tooth movement and at the same time, preserve the alveolar bone on the pressure side of orthodontic tooth movement, and the optimal dose of PRP for the best clinical performance is 11.0–12.5 folds.

**Keywords:** tooth movement, orthodontist and patient, submucosal injection, PRP, shorter treatment.

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## INTRODUCTION

Orthodontic tooth movement is the product of a biological response to interference in the physiological equilibrium in the dentofacial complex by an externally applied force. Many approaches have been carried out to accelerate the rate of orthodontic tooth movement. One of the most recently used local agents to accelerate the rate of orthodontic tooth movement is platelet-rich plasma (PRP) [1]. The healing wound process initiates through formation of clot, followed by proliferative stage which comprises of new epithelial formation, blood vessel formation, granulation tissue formation, deposition of collagen and finally maturation and contraction of collagen [2]. This process involves aggregation and adherence of platelets which favours the formation of thrombin and fibrin. Platelet-rich plasma (PRP) which is considered to be a rich source of autologous growth factors, is defined as an autologous concentration of platelets in a small volume of plasma. GFs are considered as natural biologic mediators which are responsible for the regulation of key cellular events which are part of the tissue repair and regeneration process. Platelets contain biologically active proteins. Binding of these proteins within a developing fibrin mesh or to the extracellular matrix creates chemotactic gradients leading to aggregation of stem cells resulting in cell migration, differentiation, and promoting repair.

Thus, use of autologous platelet concentrates is a promising application in clinical situations requiring rapid healing [3].

### PRP: definition and biological composition

Platelet-rich plasma (PRP) is an autologous concentration of human platelets in a small volume of plasma. Basically, it comprises of the concentrated platelets and the seven-fundamental growth factor which are actively secreted by platelets for commencement of wound healing [4]. In 1998, Robert Marx introduced PRP in dental literature as an adjunct in mandibular reconstructive procedure, enhancing the radiographic maturation rate of the graft alone.

### Growth Factors Include

- 3 isomers of platelet-derived GF (PDGF $\alpha\alpha$ , PDGF $\beta\beta$ , and PDGF $\alpha\beta$ ),
- 2 of the numerous transforming GFs-b (TGF $\beta$ 1 and TGF $\beta$ 2),
- Vascular endothelial GF (VEGF), and
- Epidermal GF (EGF)

A small volume of plasma encompassing the platelet concentration contains three cell adhesion proteins viz. fibrin, fibronectin, and vitronectin, which are essential for osteoconduction and osteoid formation,

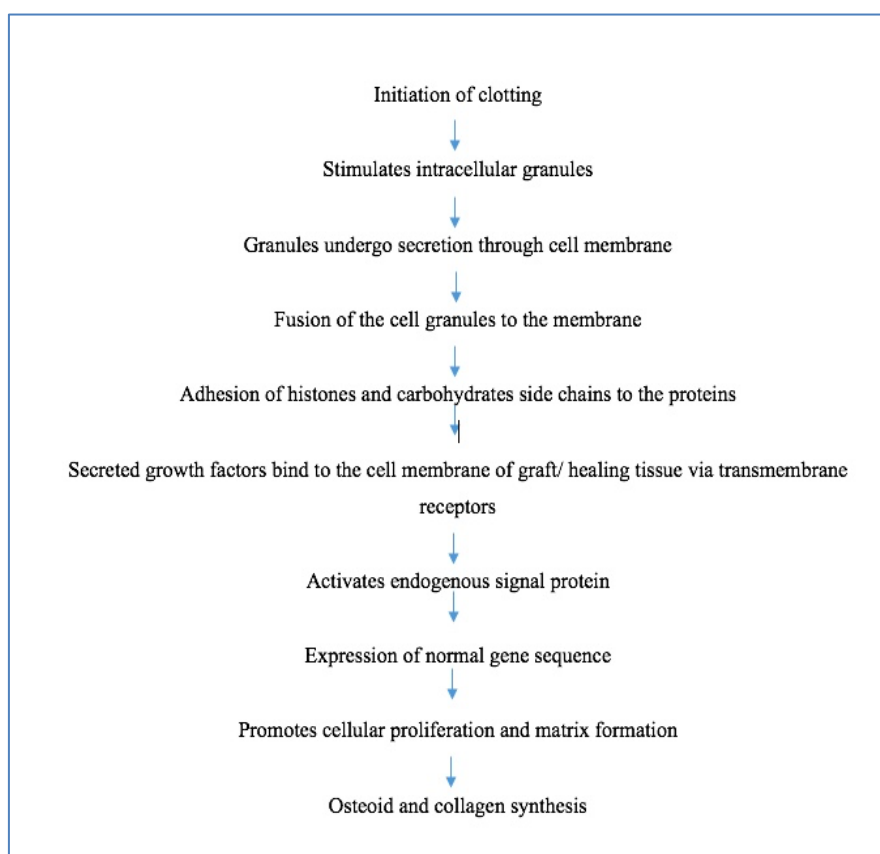
connective tissue linkage, and epithelial migration., all of which are critical in the process of healing [5].

### Mechanism of action

The action of PRP is initiated with the degranulation of cellular alfa-granules consisting of growth factors and cytokines which are formed during the clotting process while the coagulation occurs. Its initiated starts with the secretion of growth factors within the first four hours of clotting process with majority messengers being derived in one-two hours. For next 5-7 days, the synthesis of additional GFs by the platelets continue after the initial burst of PRP-GFs

following the stimulation of healing process through inflammatory macrophages by secretion of similar growth factors through inflammatory macrophages. Thus, the wound healing rate is mostly dependent on the quantity of platelets present in the blood clot. PRP being a rich source of platelets provides an increased concentration of GFs thus boosting the cellular activity and enhancement of healing procedure [4].

The process of release of cytokines and their interaction with the cells can be appreciated in the figure [6].



### Synthesis of PRP [4]

The application of PRP in dental procedures, focus on wound healing and reconstruction, has largely been in the gel form, which in contrast to conventional medical procedure, is prepared as gelled admix of PRP with  $\text{CaCl}_2$  and thrombin.

This combination causes a booster action of the PRP with instantaneous release of growth factors alike a bolus dose. However, in orthodontic treatment, a long duration of action with constant and slow release is ideally desirable, keeping the duration of orthodontic treatment duration in mind.

The process of creation of PRP involves the use of machine centrifugation process, which should be sterile and precisely suited to platelet separation from

the RBC and their sequestration in high concentration without damaging or losing the platelets and their secretory potential while considering that autologous PRP should be prepared under aseptic processing procedures only.

The following procedure, as described by Eric Lou *et al.*, can be used to prepare injectable PRP solution.

- Volume of 60 ml of whole blood is drawn from the medial cubital vein of a patient using three 30 ml syringes that each contained 3 ml of 10% sodium citrate solution as an anticoagulant.
- Heparin is not recommended for using as the anticoagulant due to its systemic effects and inducing alveolar bone resorption.
- One ml of the blood is used for checking the platelet counts.

- The remaining 59 ml of whole blood is first centrifuged at 1000 rpm for 12 min at room temperature.
- The blood is then separated into its three basic components as the RBCs at the bottom, the buffy coat (platelets) in the middle, and the poor platelet plasma (PPP) at the top.
- The RBCs are discarded, and the remaining buffy coat and PPP are collected and centrifuged again at 3000 rpm for 8 min.
- After the second centrifugation, the PPP is removed until 4 ml remained, and then the remaining PPP is mixed with the buffy coat to become PRP.

#### The regimen for use of PRP injections by Liou *et al.* [7]

Frequency	Time of injection	Purpose
Single	Beginning of treatment	Alignment and leveling
Two	Beginning and six months after the first injection	Anterior Retraction
Two	Beginning and six months after the first injection.	Protraction of posterior teeth

#### PRP and tooth movement

Orthodontic tooth movement is because of the gradual remodelling occurring in the supporting alveolar bone which involves the process of osteoclastic resorption of established bone and osteoblastic formation of new bone. The eminence of orthodontic tooth movement is dependent on the turnover rate of alveolar bone. For reducing the duration of orthodontic treatment and to move the teeth faster, alteration of the balance between resorption and deposition is required [8].

Use of PRP has shown to increase the rate of orthodontic tooth movement as it is based on Rapid Acceleratory Phenomenon.

Mangal *et al.* [4] conducted a study and concluded that localized acceleration of tooth movement through PRP is dependent on the concentration used and advised the method of synthesis for the success of accelerating tooth movement.

Banu *et al.* [9] conducted a study and concluded stating that Injection of both moderate and high concentrations of PRP may accelerate orthodontic tooth movement by decreasing alveolar bone density on paradental tissues by enhancing osteoclastic activity in a transient way.

Azita Tehranchi *et al.* [10] conducted a study and concluded that application of LPRF combining orthodontics and surgery, may accelerate OTM, particularly in extraction cases.

Theerasak Nakornnoi *et al.* [11] Concluded by saying that Local injection of L-PRP resulted in a transient increase in the rate of tooth movement and higher osteoclast numbers.

#### CONCLUSION

PRP has been applied for its osseointegration capabilities in implant dentistry and for augmentation of alveolar bone height in maxillary sinus lift. Based on these proven properties a suitable PRP for orthodontic purposes should be injectable with long lasting effect. To develop an injectable PRP with a prolonged effect

on the target tissue, a simple approach has been formulated without mixing with CaCl<sub>2</sub> and thrombin, so that it could be maintained in a liquid form and be injectable. Has been observed that fastest rate of acceleration is during the second to fourth month after the injection. Thus submucosal injection of PRP is a clinically feasible and effective technique to accelerate orthodontic tooth movement and at the same time, preserve the alveolar bone on the pressure side of orthodontic tooth movement, and the optimal dose of PRP for the best clinical performance is 11.0–12.5 folds with high clinical significance.

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