

## Review Article

### An updated review on accelerated Orthodontic Tooth Movement using Plasma Rich Protein

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#### ABSTRACT:

In recent times, demand and need for orthodontic treatment have increased with the advancement of accelerated orthodontic treatment. Currently, submucosal injection of platelet rich protein is a technique developed for accelerating orthodontic tooth movement by simulating the effect of bone without any loss of alveolar bone and surgical procedure. The current review article discusses about composition, preparation, mechanism, side effects and effects of PRP on orthodontic tooth movement.

**Keywords:** Orthodontic tooth movement, Alveolar bone, Plasma rich protein.

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#### INTRODUCTION

Based on early literatures, a comprehensive orthodontic treatment takes an average time period of less than 2 years to complete<sup>1</sup> because of the remodelling process of the bone. Many factors involved in determining the duration of the treatment are case severity, an extraction or non-extraction approach, clinical expertise, and patient cooperation. Longer treatment times cause increased risk of root resorption and decalcification<sup>2</sup>. So, the concept of regional acceleratory phenomenon was introduced by Frost in the year 1983, it is a tissue reaction to different noxious stimuli<sup>3</sup>. RAP is characterised as acceleration of normal cellular activity as an SOS phenomenon of the body. In alveolar bone RAP is characterised at the cellular level by the increased activation of the basic multicellular level, by increased activation of basic cellular units which in turn increases the remodelling space and it increases the rate of orthodontic tooth movement.<sup>4</sup>

Numerous methods to accelerate tooth movement that can be divided into surgical and non-surgical methods. The surgical methods include alveolar decortication, corticotomy, distraction of the periodontal ligament, and distraction of the dento-

alveolus<sup>5</sup> orthognathic surgery, piezocision, piezopuncture and micro-osteoperforation. Non-surgical techniques include low-intensity laser irradiation, resonance vibration, pulsed electromagnetic fields, electrical currents, pharmacological approach such as the injection of prostaglandin or relaxin<sup>6-8</sup>. The above mentioned approaches are proven to be effective, but it vary largely in the degree of effectiveness. The corticotomy procedure are invasive procedures which is much more efficient than the non invasive procedures like micro-osteoperforations or peizopuncture.<sup>9</sup>

Consequently, in order to achieve effective biological response from the minimally invasive procedure, biochemical adjuncts may be used. Platelet rich plasma (PRP) is one more approach in tissue regeneration which has been extensively used in various surgical fields. PRP was introduced into dentistry by Robert Marx. PRP is a volume of autologous plasma that has a platelet concentration above baseline<sup>10</sup>. The injection of PRP accelerates orthodontic tooth movement by decreasing the alveolar bone density due to increased activity of osteoclast. This review article discussed about

composition, preparation, mechanism, side effects and effects of PRP on orthodontic tooth movement.

### Plasma rich protein

PRP is defined as an autologous concentration of platelets in a small volume of plasma and is considered to be a rich source of autologous growth factors (GFs)<sup>10</sup>. These growth factors are secreted by the platelets to help in the process of wound healing.

### Composition of PRP

There are seven fundamental growth factors present in the prp out of which<sup>11</sup>

- 3- are isomeres of platelet derived factors [ PDGF $\alpha\alpha$ , PDGF $\beta\beta$ , PDGF $\alpha\beta$ ]
- 2- transforming growth factors [TGF $\beta$ 1 and TGF $\beta$ 2]
- Vascular endothelial growth factor
- Epithelial growth factors
- They also contain 3 proteins which acts as cell adhesion molecules for osteoconduction and matrix for bone, connective tissue and epithelial migration. The cell adhesion molecules present are fibrin, fibronectin, vitronectin.

### Preparation of PRP

PRP prepared by this method is short lived It is prepared by mixing the extracted PRP with 10 ml of 10% calcium chloride and 10000 unit of bovine thrombin. It involves the use of 10ml syringe for each mix, which has 6 ml of PRP, 1ml of calcium chloride and thrombin mix and 1 ml of air to act as a mixing bubble while agitating to form a clot. For the use in orthodontics the PRP should be injectable and long lived. In order to develop a PRP with long standing effect, avoid mixing with calcium chloride or thrombin. As a result, it remains in liquid state and can be injectable.

### Process of preparation

400 to 450 ml of autologous whole blood through central venous catheter is used to draw blood at centrifuge speed of 5600 RPM, blood is drawn at rate of 50 ml/min, then 1 ml of citrus phosphate dextrose to 5 ml is added to prevent coagulation. Blood is centrifuged to red blood cells, protein rich plasma (buffy coat) and protein poor plasma Further, red blood cells forms the lowest layer, PRP the middle layer and PPP top layer. The cell separator separates PPP first(200 ml), PRP second about (70 ml), residual RBC about( 180 ml).Once PPP is collected the RPM is lowered to 2400 to allow precise separation of PRP from red blood cells. Finally, PRP is obtained

### Mechanism

PRP being a rich source of platelets act as the supplement source, and provides an increased concentration of GF during the phase of healing. This support the cellular activity and boosts the healing

procedure. The success of the PRP achieved by autologous sources and pre-synthesised homologous should be avoided.

PRP is derived through degranulation of cellular alfa-granules and it consist of growth factors and cytokines. These biochemical messengers generate during the clotting process while the coagulation occurs. In first hour of the process of clotting, it initiates growth factors secretion. Consequently, PRP must be synthesized in an anticoagulated state and used within ten minutes of clot initiation. But PRP remains viable for up to 8 hours in sterile environment.

During an initial burst of PRP-GFs, the synthesis and secretion of the GFs by the platelets maintain for the lifespan of 5-7 days. Henceforth, the inflammatory macrophages, continue to stimulate healing by secretion of similar growth factors. Therefore, the number of platelets in the blood clot within the graft, wound, or adherent to a flap sets the rate of wound healing.. This ensures HLA compatibility at the site of application<sup>11</sup>.

### Use of PRP in orthodontics

- It accelerates tooth movement
- Reduces post-surgical pain in patients treated with periodontally accelerated osteogenic orthodontics
- Promote the bone formation in alveolar cleft repair patients<sup>12,13</sup>

### Preparation of site to receive PRP

Local anaesthesia like xylocaine is injected at the site of target before the administration of PRP to lessen pain at the target site. PRP is a submucosal injection, for each target site 0.7 ml PRP is injected. NSAID drugs were shown to neutralise the action of PRP, hence it should be avoided for patient undergoing PRP treatment<sup>14</sup>.

### Application of PRP in orthodontics

#### Effects of PRP on orthodontic tooth movement

1. A Study by **Rashid et al** showed that intraligamental injection of PRP showed increase in rate of orthodontic tooth movement in the PRP group when compared to the control group after the first week. Rate of orthodontic tooth movement in the PRP group was twice that of control group especially in the third week<sup>15</sup>.
2. **Sibel Akbulut et al** showed that 4.5 folds higher dose of PRP did not act as an adjunct to orthodontic tooth movement<sup>16</sup>.
3. **Aysegul et al**<sup>17</sup> suggested that injection of both moderate and high platelet enhances orthodontic tooth movement by regional osteoclastic activity. The alveolar bone density was decreased in the experimental group when compared to the control group at 3, 7, 14, 21 days. The hPRP-E group showed 1.7 times faster orthodontic tooth

movement than the control group and 1.4 times faster orthodontic tooth movement than mPRP-E group at the end of 21 day.

4. **Ahmed. El. Timamal**<sup>18</sup> suggested that the rate of canine retraction on the intervention side increased by 15% and on the second month by 5% . During cessation of PRP injection the rate of canine retraction on the intervention side was slower than the control side by 40%. This result showed positive correlation between the injection of PRP and rapid orthodontic tooth movement

**Effects of PRP in cleft patients**

1. **Chandan gupta et al**<sup>19</sup> showed that bone grafts with added PRP had increased bone density when compared to grafts without PRP at end of 6-month postoperative. The mean bone density was 1.04 times more in the PRP group than non PRP group at 3-month and 1.2 times more at 6 months. PRP seems to improve bone formation in alveolar clefts when admixed with autologous cancellous bone harvested from the iliac crest.
2. **Giuseppe Giudice et al**<sup>20</sup> PRP improves the quality of osteoblastic activity and it accelerates bone healing and it initiates early orthodontic treatment.
3. **Reiko sakio et al**<sup>21</sup> concluded that there was no evidence to suggest that autologous PRP is of value for effect on the bone resorption for alveolar bone graft.
4. **Tomoki oyama et al**<sup>22</sup> Use of PRP was a good source of growth factors and easy to extract it enhances osteogenesis of alveolar bone grafting in cleft patients. The volume of regenerated bone in alveolar cleft with PRP was higher than in controls.

**Effect of PRP on alveolar ridge preservation**

**Kim et al**<sup>23</sup> suggested that the placement of occlusive membranes to cover the extraction socket entrance are techniques intended at reducing alveolar ridge resorption and enhancing bone formation. Absorbable gelatin spongy or gelatin spongy soaked with platelet rich plasma (PRP) showed improved wound healing it has preservation effect on the extraction socket and stimulates bone formation process after extraction.

**Dosage of PRP and its effects**

The regimen suggested by Liou et al<sup>14</sup> is as mentioned in the following table.

Frequency of injection	Time of injection	Function
<b>Single</b>	Beginning of the treatment	Alignment and levelling.
<b>Two</b>	Beginning and 6 months after first injection	Anterior Retraction
<b>Two</b>	Beginning and 6 months after first injection	Protraction of posterior teeth

Gulec et al<sup>17</sup> it was observed that the PRP effect is dose dependent with the effect of the high concentration of PRP lasts for longer, and it enhances the rate of tooth movement, as much as up to 1.7 times.

Choi et al<sup>24</sup> concluded that the rate of bone cell proliferation reduced with increasing the concentration (>5%) of PRP

**Adverse effect of PRP injection**

Acceptable discomfort like mucosal swelling, irritation, itching sensation and mild to moderate pain was experienced by eighty five percentage of people after 6-12 hours postinjection.

A study shows that 15% of patients experienced severe pain, the intensity of post injection discomfort increased with the increase in concentration of the injected PRP.

**Systemic effects of PRP**

Submucosal injection of PRP could lead to systematic alteration of blood parameters including Alkaline phosphatase, gamma GT, Serum albumin and Serum total protein and this alteration may be related to liver function impairment, in addition to increase in the level of Platelet Distribution Width and calcium<sup>25</sup>.

**CONCLUSION**

Major problem encountered during surgical methods are removal of bone for initiating orthodontic tooth movement. Therefore, the use of PRP could be a superior method to accelerate tooth movement. During different stage of orthodontic treatment, use of injectable PRP can develop the quality of the treatment outcome by influencing the bone quality and enhancing the rate of tooth movement.

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