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ACCELERATED TOOTH MOVEMENT USING PLASMA RICH PROTEIN-A CRITICAL REVIEW

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ABSTRACT:

The accessibility of orthodontic treatment has increased the number of patients opting for the treatment. Orthodontic treatment has shown to improve the overall well-being of the patient. Still, there are many disadvantages to orthodontic treatmentof which patient acceptability to prolonged orthodontic treatment is of primary concern. Many surgical and non-surgical methods have been developed and employed to hasten the treatment. Amongst various methods used this review article will highlight the use of protein rich plasma(PRP) as an adjunct to accelerate tooth movement, which acts by the changing the alveolar bone density due to the presence of osteoclast.

Keywords: Orthodontic tooth movement, alveolar bone density, osteoclast

I. INTRODUCTION

The demand and need for orthodontic treatment have amplified in recent times with the advancement of more aesthetic orthodontic treatment modes and increase in the patient desire to look more aesthetically acceptable. This upsurge in need for treatment is accompanied by the patient request to finish the treatment earlier. Based on early literature it is said that, a comprehensive orthodontic treatment takes an average treatment period of less than 2 years to complete[1]. However there are several factors which play an important role in determining the duration of the treatment like case severity, an extraction or non-extractionapproach, clinical expertise, and patient cooperation. For example, research indicated that the correction of class II cases took longer duration followed by class III and class I[2].

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Longer treatment times causes elevation in the risk of root resorption and decalcification[3]. Treatment of shorter duration is acceptable by the patient and has increased advantages.

Tooth movement is induced by physical stimulus which involves series of biological reactions of the alveolar bone, periodontal ligament, the gingiva, and the vascular and neural network. Tooth movement is an inflammatory process which involves resorption and apposition of the bone by osteoclast and osteoblast cells, this leads to bone remodelling at that site[4].

The concept of regional acceleratory phenomenon was given by Frost in the year 1983,it is a tissue reaction to different noxious stimuli[5].

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. This increases the rate of orthodontic tooth movement [6].

There are various methods to accelerate tooth movement that can be categorised as surgical and non-surgical methods.

The surgical methods include alveolar decortication, corticotomy, distraction of the periodontal ligament, and distraction of the dento-alveolus[7].

Non-surgical techniques include low-intensity laser irradiation, resonance vibration, pulsed electromagnetic fields,electrical currents, and pharmacological approaches.Low laser therapy is reported to stimulate osteoblast and osteoclast cell proliferation, and enhance the velocity of tooth movement due to accelerated bone remodelling mediated by the RANK/RANKL/OPG system[8,9].Light orthodontic force combined with the application of vibratory stimuli using an electric toothbrush enhanced the secretion of IL-1β in GCF and accelerated orthodontic tooth movement[10].

The use of invasive techniques like corticotomy has shown to be much more effective than the non invasive procedures like micro-osteoperforations or peizopuncture[11]. There are various other uses of PRP in orthodontics in which the use of PRP in accelerating tooth movement is of utmost importance.

This review article high lights the use of Platelet-rich plasma (PRP) in acceleration of tooth movement. PRP was introduced into dentistry by Robert Marx. PRPis a volume of autologous plasma that has a platelet concentration above baseline[12].The injection of PRP accelerates orthodontic tooth movement by decreasing the alveolar bone density due to increased activity of osteoclast.

What is PRP?

PRP is defined as an autologous concentration ofplatelets in a small volume of plasma and is considered to bea rich source of autologous growth factors (GFs)[13]. 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[14]

- 3- are isomeres of platelet derived factors [PDGFαα, PDGFββ, PDGFαβ]
- 2- transforming growth factors [TGFβ1 and TGFβ2]
- Vascular endothelial growth factor
- Epithelial growth factors

They also contain 3 proteins which acts as cell adhesion molecules for[14]

- Osteoconduction
- Matrix for bone, connective tissue and epithelial migration.

The cell adhesion molecules present are[14]

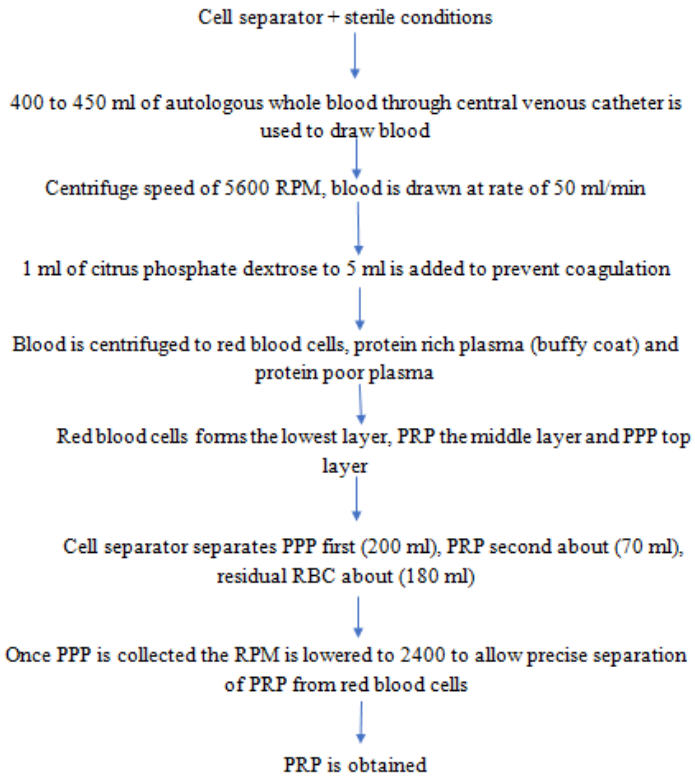
- Fibrin
- Fibronectin
- Vitronectin

Preparation of PRP

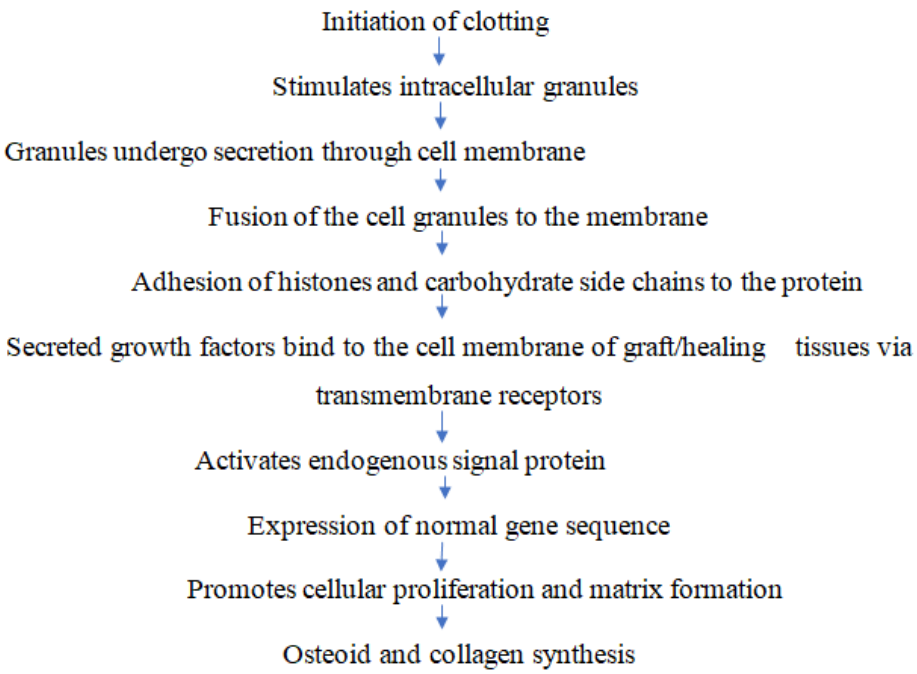
PRP used is dentistry is prepared by mixing the extracted PRP with 10 ml of 10% calcium chloride and 10000 unit of bovine thrombin. It involves the use of 10ml syringe for each mix, which has 6 ml of PRP, 1ml of calcium chloride and thrombin mix and 1 ml of air to act as a mixing bubble while agitating to form a clot. PRP prepared by this method is short lived[14].

For the use in orthodontics the PRP should be injectable and long lived. To develop a PRP with long standing effect it is not mixed with calcium chloride or thrombin, thus it remains in liquid state and is injectable.

Process of preparation[14]



MECHANISM OF PRP[14]



The anti inflammatory effect of PRP is attributes to the healing potential of the boneby directly influencing the monocytic secretory activity.

- It promotes the manufacturing of RANTES (regulated on activation, normal t-cell expressed and secreted).
- It blocks MCP-1 (monocyte chemotactic protein) release from monocytes.
- Increases the concentration of LXA4, suggesting that PRP facilitates healing by controlling the local inflammatory response.
- PRP suppresses cytokine release, limit inflammation and promote tissue regeneration[15].

Use of PRP in orthodontics accelerates tooth movement, reduces post-surgical pain in patients treated with periodontally accelerated osteogenic orthodontics and promote the bone formation in alveolar cleft repair patients[16,17]

Preparation of site to receive PRP

Local anaesthesia xylocaine is injected at the site of target before the administration of PRP to alleviate 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 they are not prescribed for patients undergoing PRP treatment[18].

Adverse reaction of PRP injection

Acceptable postinjection 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. 15% of patients experienced severe pain, the intensity of post injection discomfort increased with the increase in concentration of the injected PRP[18].

Effects of PRP on orthodontic tooth movement

Study by **Aysegul et al[19]** suggested that the alveolar bone density was decreased in the experimental group when compared to the control group at 3, 7, 14, 21 days. The changes in the alveolar bone density begin as early as day 3 and was increased at day 7. There was increase in TRAP+ cells in the high platelet concentration experimental group and low platelet concentration experimental group. Decrease in alveolar bone density was also seen in control group as early as 3 days but there was alag between the 3rd and 7th day.At the end of day 21, 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 did the mPRP-E group. Injection of both moderate and high platelet enhances orthodontic tooth movement by regional osteoclastic activity.

Rashid et al[20]conducted study and result 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. The resorption side showed increased osteoclastic activity in the PRP group compared to the control group. In the apposition side there was increase woven bone formation in the PRP group compared to the control group this increased osteogenesis was due to increased stretching of the PDL due to rapid tooth

movement in the PRP group along with the healing effects of PRP.Study by **SibelAkbulut et al**[21] showed that 4.5 folds higher dose of PRP did not act as an adjunct to orthodontic tooth movement.

Gulec et al[22] results showed that on day 3 the alveolar bone density between the upper first molar roots were reduced in the high platelet concentration group when compared to the control group this was seen for 21 days. Thus, he concluded that injection of high concentration PRP increases the orthodontic tooth movement by transient decrease in the alveolar bone density.

Study by **Ahmed. El. Timamal**[23] suggested that the rate of canine retraction on the intervention side increased by 15% and on the second month by 5%. This result showed positive correlation between the injection of PRP and rapid orthodontic tooth movement. In the third month and after the cessation of PRP injection the rate of canine retraction on the intervention side was slower than the control side by 40%. This decrease in the tooth movement could be due to the negative feedback mechanism of the growth factors, there is regional increase in the growth factor due to the local injection of PRP which affects the normal production of growth factors during the orthodontic tooth movement[24,25].In the last month of study period there was no significant difference in the rate of tooth movement in the control and intervention side.

II. Other uses of PRP in orthodontics

Effects of PRP in cleft patients

Study by **Chandanguptaet al**[26] showed that bone grafts with added PRP had increased bone density (1028.00 ± 11.30 HU) when compared to grafts without PRP (859.50 ± 27.73 HU) at end of 6-month postoperatively. 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. Primary healing was observed in 90% of PRP group, pain and swelling was less in PRP group. PRP seems to enhance bone formation in alveolar clefts when admixed with autologous cancellous bone harvested from the iliac crest.**Giuseppe Giudice et al**[27]suggested use of PRP improves the quality of osteoplastic activity, accelerates bone healing and favours early orthodontic treatment. **Reiko sakio et al**[28] concluded that there was no evidence to suggest that autologous PRP is of value for effect on the bone resorption for alveolar bone graft.

Tomoki oyama et al[29] 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 control group.**C lee et al**[30] suggested that PRP may enhance bone remodelling in the early phase, but it was inadequate for bone resorption following secondary bone graft in the long term.

Effect of PRP on alveolar ridge preservation

Shi b et al[31] concluded in their animal study that the use of calcium sulfate hemihydrate/PRP in the fresh extraction socket reduced alveolar bone resorption and improved bone metabolism.**Kim et al**[32] suggested that the placement of occlusive membranes to cover the extraction socket entrance are techniques aimed at reducing alveolar ridge resorption and enhancing bone formation.Application ofabsorbablegelatin spongy or gelatin spongy

soaked with platelet rich plasma(PRP) showed improved wound healing and has preservation effect on the extraction socket and stimulates bone formation process after extraction.

Dosage of PRP and its effects

a) Single dose of PRP in the beginning of treatment brings about levelling and alignment

b) One injection in the beginning of treatment and another injection after 6 months acts as a booster dose bringing about anterior retraction.

c) One injection in the beginning of treatment and a booster dose after 6 months for protraction of the posterior teeth[18].

Systemic effects of PRP

Submucosal injection of PRP could lead to systematic alterationof bloodparameters including alkaline phosphatase,gamma GT, Serum albumin andSerum total protein and this alteration may berelated to liver function impairment, in addition to increasein the level of platelet distribution and calcium[33].

III. Conclusion

The use of other surgical methods to accelerate tooth movement requires excess removal ofbone. The rate of tooth movement depends on the extent of the bone removed[34]. The most widely used method to accelerate tooth movement are surgical methods but they has various disadvantages such as increased cost, highly aggressive and invasive[35]. Thus, use of PRP could be a better substitute to accelerate orthodontic tooth movement.

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