

Overview of platelet-rich plasma: Orthodontics perspective

Sandhya Jain, Anil K. Bunkar

Department of Orthodontics, Government College of Dentistry, Indore, Madhya Pradesh, India

Correspondence:

Anil K. Bunkar, Room Number 11, 2nd Floor, Government College of Dentistry, Opposite to M.Y. Hospital, Shivaji Square, Indore - 452 001, Madhya Pradesh, India. Phone: +91-8463875900. E-mail: anilkumar8984@gmail.com

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Abstract

Background: Platelet-rich plasma (PRP) is an autologous concentration of human platelets in a small volume of plasma. It comprised several fundamental growth factors which actively work for the initiation of the wound healing process of both soft and hard tissues. PRP in dentistry is in use since 1998 for many reasons, one of which is the orthodontic tooth movement. Many studies have been performed to check the role of PRP in orthodontic tooth movement and most of them found it is an effective method with fewer drawbacks compared to other methods. **Aim:** This article aims to highlight the effects of PRP in orthodontic tooth movement. **Conclusion:** PRP is an effective and simplest method to accelerate orthodontic tooth movement. **Clinical significance:** It can be used to reduce the time for treatment by incorporating it into our routine treatment practice.

Keywords: Platelet-rich plasma, orthodontic tooth movement, malocclusion

Introduction

Lots of people in the world are suffering from malocclusion, which is preventable. According to the literature, malocclusion is rank third among worldwide public health dental issue in priority after dental caries and periodontal disease.^[1] Malocclusion is not a disease but it may cause structural, functional, and esthetic impairment affecting quality of life.^[2] The orthodontic treatment usually takes more than 2 years of time to complete.^[3] Many patients avoid the treatment due to long duration of treatment. Usually, patients expect the duration for treatment to be around 6–12 months.^[4] Attempts to accelerate orthodontic tooth movement can be classified into biological, physical, biomechanical, and surgical approaches [Table 1].^[5] Human relaxin and intermittent dose of PTH are not very effective to accelerate orthodontic tooth movement.^[6,7] PGE1 has been studied in human trials with a split-mouth experiment which exhibited 1.6-fold faster result than the control side.^[8] However, its use did not gain much popularity due to increased risk of root resorption and increased pain levels.^[9,10] Surgical approaches cause rapid tooth movement,^[11] but these methods lead to injury to the periodontium, alveolar bone resorption, and increased osteoclastic activity.^[12,13] Most of the time surgery to accelerate orthodontic tooth movement is also not accepted by patients. Autologous platelet-rich plasma (PRP) could be better option to accelerate orthodontic tooth movement.

History of PRP

According to the literature, PRP was developed around the 1970s and first used in 1987 by Ferrari in cardiothoracic surgery. Then, from the mid-90s, it started gaining popularity and was applied in many different medical fields such as general surgeries, dental surgeries, sports medicine, and cosmetic surgeries.^[14]

PRP was introduced to dentistry by Robert Marx in 1998 for the mandibular reconstructive procedure to increase the radiographic maturation rate of the bone graft.^[15]

Composition of PRP

Platelets comprised seven fundamental growth factors which actively work in the initiation of the wound healing process of both soft and hard tissues.^[16]

Following are the growth factors found in PRP

- Platelet-derived growth factors – PDGF α , PDGF β , and PDGF γ ,
- Numerous transforming growth factors – TGF β 1 and TGF β 2,
- Vascular endothelial growth factor,
- Epidermal growth factor.

These growth factors act as an important source in the regulation and stimulation of the wound healing process. They play an important role in regulating cellular processes such as mitogenesis, chemotaxis, differentiation, and metabolism.^[17]

PRP in Orthodontics

PRP in general dentistry used in the gel form. Calcium chloride (CaCl₂) and thrombin are mixed to coagulate the platelets to gel form. CaCl₂ and thrombin initiate and activate the burst release of all growth factors at once and make an action of duration shorter while PRP in orthodontics is used in injectable form which requires long duration of action. PRP in the liquid and injectable form is prepared without mixing CaCl₂ and thrombin.^[18]

Preparation of PRP

PRP for the orthodontic purpose in injectable form is prepared by a method described by Eric Liou.^[18]

A 60 ml of blood is drawn from medial cubital vein and mixed with 9 ml of 10% sodium citrate as an anticoagulant (heparin is not used because it induces alveolar bone resorption). Out of this, 1 ml of blood is used to check platelet count. Remaining blood is centrifuged at 1000 rpm for 12 min at room temperature to separate it into three basic components; red blood cell (RBC) at bottom, buffy platelet coat at middle, and poor platelet plasma (PPP) at the top. RBC is discarded and remaining two coats are again centrifuged at 3000 rpm for 8 min. After that, PPP at top is removed except the remaining 4 ml. This remaining PPP and bottom buffy coat are mixed to form PRP. Out of this, 1 ml of the PRP is analyzed to check its platelet count.

The Regimen of PRP for Orthodontic Tooth Movement

Liou suggested a PRP regimen for orthodontic tooth movement in which he stated that, for alignment and leveling, one injection of PRP should be given at the starting of the treatment. If anterior retraction or posterior protraction to be done with alignment and

Table 1: Different approaches to accelerate orthodontic tooth movement

Biological	Physical and biomechanical	Surgical
Relaxin ^[6]	Vibrational stimulation	Osteotomy ^[11]
Parathyroid hormone ^[7]	Resonance vibration	Corticotomy ^[12]
Prostaglandins E1, E2 ^[8]	Direct electric current	Interseptal alveolar surgery
1-25(OH)2 D3 ^[10]	Low-level laser therapy	
Osteocalcin		
Cytokine IL-1		

leveling, then two injections should be given, the first injection at the starting of treatment and second booster injection should be given after 6 months of the first injection [Table 2].

Mechanism of Action of PRP on Resorption and Apposition Side

Effect of PRP on resorption side

It causes vasodilation and increase resorptive activity (more osteoclastic activity) in the socket. PRP increases size and number of blood vessels and also cementoblastic activity to preserve root surface intact.

Effect of PRP on apposition side

PRP increases interstitial space with dilated blood vessels along with well-formed nerve fibers. It also causes more osteoblastic and cementoblastic activity.^[19] These nerve fibers could have an influencing role in the active osteogenesis through the production of neurotransmitters which enhance secretion of cytokines and their activation.^[20]

Different Studies Related to PRP

Eric Liou found two-fold acceleration of tooth movement without any bone loss on the pressure side.^[18]

Rashid *et al.* studied “Effect of PRP on orthodontic tooth movement in dogs” by injecting 25 units of PRP followed by 25 units of thrombin-CaCl₂ on the experimental side and 50 units of thrombin-CaCl₂ as placebo on the control side. He found significantly faster tooth movement on the experimental side (mean movement 15.60 mm) compared to the control side (mean movement 9.46 mm).^[19]

Güleç *et al.* in his study also found higher orthodontic tooth movement on experimental side compared to control side.^[21]

Akbulut *et al.* used PRP to check its effect on orthodontic tooth movement and found no beneficial effect in orthodontic treatment.^[22]

Table 2: PRP regimen for orthodontic tooth movement suggested by Eric Liou

Purpose	Frequency of injection	Time
Alignment and leveling	One injection	At starting of treatment
Alignment and leveling with anterior retraction	Two injections	First injection at beginning of treatment and another booster of injection 6 months after the first injection for the purpose of anterior retraction
Alignment and leveling with posterior teeth protraction	Two injections	First injection in the beginning and another booster of injection 6 months after the first injection for the purpose of protraction of posterior teeth

Nakornnoi *et al.* injected leukocyte PRP locally in rabbit and found local injection of L-PRP causes transient increase in rate of tooth movement.^[23]

Safety of PRP and the Possibility of Infection

Source of blood for PRP is autologous so chances of blood transfusion-transmitted diseases are negligible. Sterilization protocol in preparation of PRP also avoids blood-borne infection. Platelet in PRP does not promote bacterial proliferation as they are essentially like natural clotting factors.^[24]

Conclusion

The use of PRP for accelerated orthodontic tooth movement is the simplest and clinically practical method. It does not cause any major discomfort to the patient. The use of PRP in different phases of treatment improves the quality of treatment and reduces treatment duration which is in the benefit of both doctor and the patient.

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