

## **A General Aspect of Platelet Rich Plasma**

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### **Abstract**

The aim of this scientific paper is to introduce Platelet Rich Plasma (PRP) cure method by people who never heard about it. People can hurt their selves, thus they can have damaged tissue; for instance broken bone, a scar or a wounded area. Furthermore damaged tissue can be a cartilage tissue, which takes very long time to heal. Platelets, those exist in the veins as thrombus, come up to repair those damaged tissues. However, platelets would be insufficient to cure damaged area in a short time. At this point PRP cure method give a hand to the healing process. By centrifuging people's own blood via special kits, platelets can be separated from blood cells as plasma. That plasma's platelet density is 3-5 times greater than that blood's platelet density. Afterwards PRP method is implemented by injection of plasma to the damaged area or tissue. After implementation of 2-4 sessions per week, damaged tissue can be regenerated. It is fast healing method because densified platelet plasma is used; and it is safe because that plasma is obtained from people's own blood. PRP can be implemented on many areas; for instance on dentistry, sports medicine, different kind of surgeries such as plastic, vascular or orthopedic and so on. When soccer players brake their legs, their sports life come to the end, but what if their broken legs was healed better and faster than general healing process? To sum up, PRP is very safe and the future of healing process.

**Keywords:** Platelet rich plasma (PRP), growth factors, tissue reparation, regenerative therapy

## Trombosit Yönünden Zenginleştirilmiş Plazmaya Genel Bir Bakış

### Özet

Bu bilimsel makalenin amacı, trombosit yönünden zenginleştirilmiş plazma (PRP, Platelet Rich Plasma) ile tedavi yöntemini daha önce hiç duymamış insanlara tanıtmaktır. İnsanlar sakatlanabilir, böylece bedenlerinde doku zedelenmeleri yaşanabilir; örneğin kemik kırığı, küçük yaralanma ya da yaralı bir bölge oluşabilir. Ayrıca hasarlı doku iyileşmesi çok uzun zaman alan bir kırıkta doku olabilir. Damarda trombus olarak bulunan trombositler, hasarlı dokularını onarmak için ortaya çıkarlar. Bununla birlikte, kısa bir sürede trombositler hasarlı alanın tedavisi için yeterli olacaktır. Bu noktada PRP tedavi yöntemi iyileşme sürecine bir el verir. Özel kitlerle santrifüj edilen insanların kanlarında trombosit, kan hücreleri ve plazmadan ayrıştırılabilir. Bu ayrıştırılmış plazmanın trombosit yoğunluğu, kandaki trombosit yoğunluğundan 3-5 kat daha fazladır. Daha sonra hasarlı bölgeye ya da dokuya plazma enjeksiyonu ile PRP yöntemi uygulanır. Haftada 2-4 seans uygulanması sonrasında, hasarlı doku yenilenebilir. Yoğunlaştırılmış trombosit plazması kullanıldığı için bu hızlı bir iyileşme yöntemidir; bu plazma insanın kendi kanından elde edildiği için de güvenli bir yöntemdir. PRP birçok alanda uygulanabilir; diş hekimliği, spor hekimliği ile plastik, damar ya da ortopedik gibi farklı tür cerrahi alanları örnek gösterilebilir. Futbolcuların bacakları kırıldığında spor hayatlarının sonuna gelirlerdi. Eğer kırılan bacakları daha iyi ve daha hızlı iyileştirilmiş olsaydı spor hayatları yine de biter miydi? Özetle PRP' yi, geleceğin güvenli tedavi yöntemi olarak tanımlayabiliriz.

**Anahtar Kelimeler:** Trombositten zengin plazma (TZP), büyüme faktörleri, doku onarımı, rejeneratif tedavi

## Introduction

PRP was developed as a side product of multi componential blood products at the beginning of 70's. Since that time, it is especially used on orthopedic (Savarino et al., 2006), periodontal (Hanna et al., 2004), maxillofacial (Marx et al., 1998), plastic (Powell et al., 2001), thoracic (Englert et al., 2005), vascular surgery (Knighton et al., 1998; Crovetti et al., 2005) and ophthalmology (Korobelnik et al., 1996). At the recent times it is also used on new indication of dermatology practices.

Naturally people can hurt their selves, break their own bone, have any kind of surgery operations and so on; thus they can have wounded area or damaged tissues. Therefore, platelet, that exists by being thrombus on the vein periphery by traveling through the blood flow, come up to repair the wounded area or damaged tissue.

Basically tissue reparation is formed in 3 periods at post-trauma, which are inflammation period, formation period and modeling period. Reparation begins with hematoma, which is cumulation of blood at the damaged area, after tissue gets damaged. Platelets in hematoma are activated and excrete growth factors.

Afterwards, granuloma, which is an anlage scar tissue, is composed. Granuloma produces the collagen, which is the constituent of proteins. After this period formation and remodeling, which is the development of quality of scar tissue, period comes through. It's thought that growth factors have effects of acceleration on reparation on this whole tissue reparation mechanism (Lyras et al., 2010).

Beside PRP method accelerates the recovery process by implementing densified growth factors to the wounded area; because of it includes bactericidal proteins, infections are taken under control and there is significant decrease of pain and swelling (Lynch et al. 1994). Beside platelets have task of running hemostasis function; they are the cells that have been focused to be researched after determination of that they had an effective role play on recovery process (Pietrzak & Eppley, 2005).

Platelet rich plasma is a cure method that is called platelet-enriched plasma treatment application (Man et al., 2001). On this medical application it is implemented by centrifuging of blood, which is taken for an amount from person, via a special implement kit; discrimination to its compounds; and derived small amount of PRP is injected back to the person (Whiteman et al., 1997).

Venous blood is taken to anticoagulant tubes (anticoagulant/blood rate: 1/10), which includes acid citrate dextrose (ACD), from the patient and then the tube is must be shaken for 10 seconds for the purpose of mixing acid citrate dextrose with blood to prepare PRP. 3 parts on tube will be seen after centrifuging at low spin (3000 rpm, 3 minutes).

Erythrocytes are seen at the bottom part, platelet-leukocyte mixture which is called buffy coat is seen at the middle part and the plasma is seen at the top part of the tube.

PRP can be used after buffy coat is taken carefully; or after re-centrifuging buffy coat and platelet poor plasma at 4000 rpm for 3 minutes, concentration of PRP will be derived (Lee et al., 2011). Because of blood travels in a closed system via sterile tubes, it has no risk of an infection, and because of derived from person's own blood, it doesn't cause to any immune or allergic reactions; thus it is a reliable medical application (Doha et al., 2006). The density and activity of platelet in PRP is 4 times of the ones in blood (Marx et al., 1998).

PRP is autogenous concentration of human platelets in a small amount of plasma, nontoxic, doesn't cause immune reactions, non-synthetic natural regeneration method and beside those, thought that accelerates natural scar process (Carlson & Roach, 2002; Kanno et al., 2005).

The main goal of preparation of PRP is to densify the concentration of platelets that have growth factors in them. The effects of growth factors, which are in platelets and induce the scar healing, are increased. The concentrations of platelet in plasma, which are derived by different systems, are increased 2-8 times, thus the growth factors that they contain are different (Zimmermann et al., 2001; Marx, 2004). Platelet rich plasma can be implemented by topical or injection.

## **PRP AND THE GROWTH FACTORS**

The growth factors are success on fixing tissue by regenerating via running the mechanism of cell repair, and because of platelet rich plasma has high density of fibrin ingredients they function as hemostatic and stabilization agents of PRP (Aspenberg & Virchenko, 2004).

The concentration of the growth factors that included in PRP is 3-5 times of included in blood. Platelets keep excreting the growth factors during the tissue regeneration process (Eppley et al. 2006).

When autologous blood combined with thrombin and calcium chloride, it causes excretion of platelet derived growth factor (PDGF), transforming growth factor  $-\beta 1$  (TGF- $\beta 1$ ) and transforming growth factor  $-\beta 2$  (TGF- $\beta 2$ ) (Marx et al., 1998).

Beside those it includes vascular endothelial growth factor (VEGF), epithelial growth factor (EGF), insulin like growth factor -I (IGF-I) and IGF-II, protein particles that are expertise on tissue healing implementation of aimed area, and osteocalcin, osteonectin, fibrinogen, fibronectin, vitronectin, trombospondin, coagulation factors and some other adhesive proteins, fibrinolytic factors, anti-proteases, cytokine (IL- $1\beta$ , SCD40L,  $\beta$  tromboglobulin), and chemokines, membrane glycoproteins, angiogenesis, g-proteins and bacterial proteins (Pietrzak & Eppley, 2005). It is shown that all factors mentioned above are in the platelets (Marx et al., 1998).

PDGF is aglicoprotein that has characteristics of mitogenic, angigenic and macrophage. TGF- $\beta$  stimulates chemotaxy of osteoblast cells, transforms the mature osteoblasts and inhibits the osteoclast formation and bone resorption (Marx, 2004).

PDGF has a very important role on healing scar by the capable of migration and proliferation of fibroblasts and capable of stimulating the polymorph nuclei leukocytes (PMNL). If metabolic effects are examined, beside it stimulates the cell growth and migration, it trespasses amino acids and synthesizes protein. Beside the positive effects on scar healing, there are positive results on treatment of periodontal class-III defects (Cho et al., 1995).

## **THERAPEUTIC EFFECTS OF PRP**

After injury, as a result of bleeding there is occurrence of thrombosis. Platelets, which are activated on wounded area, excrete PDGF, TGF- $\beta 1$  and EGF. Cells, which are neighbor to wounded area, also excrete PDGF, TGF- $\alpha$  and TGF- $\beta 1$  in 1-2 hours after injury.

At the same time macrophages, which come to the wounded area, also have a role by being source of PDGF, TGF- $\alpha$  and TGF- $\beta$ 1. All growth factors have positive effects on tissue repair. PDGF increases scar cells by mitogenesis and develops new capillary by angiogenesis. It also organizes fibroblastic and osteoblastic functionalities (Lind, 1996).

Growth factors are presented excessively in secretor molecular young platelets known as cytokine, chemokines and integrin, and they also kept excreted at a small amount for 7-10 days, which is lifetime of a platelet. PDGF differentiates monocytes and neutrophils, and increases the number of fibroblasts on damaged area by stimulating growth of endothelial cells.

Thus increasing collagen production, capillary vascular formation and granulation formation are supported. TGF- $\beta$  is vital on regeneration of skin. For instance, beside it joins to inflammatory response with PDGF and stimulates extra cellular matrix synthesis (Tamariz-Dominique et al., 2002). EGF has a role on chemotaxis and stimulates reproduction of keratinocyte and fibroblasts. Fibroblasts, which are increased in number, increase the production of collagens. VEGF stimulates reproduction of endothelial cells, thus, increases the new vascular formation, existing capillary vascular disorder and helps, to microenvironment, which is needed for angiogenesis and cell growth. Insulin like growth factor (IGF), IGF-1 and IGF-2 have a chemotactic role on vascular endothelial cells.

This process finally stimulates the migration of vascular endothelial cells to the damaged area, supports angiogenesis and increases endothelial and epidermis regeneration rate with PDGF (Tamariz-Dominique et al., 2002; Eppley et al., 2004; Na et al., 2011; Lee et al., 2011; Crovetti et al., 2004).

## Conclusion

PRP cure methods are increasingly used on sports medicine, orthopedic and traumatic operations, dentistry, neurosurgery, ophthalmology, urology, sound heading, cosmetic, dermatological and plastic, angiogenesis processes such as cardio by-pass operations, damages and looseness of bone, muscular and connective tissues such as corneal epithelial defects and maxillofacial surgery (Bhanot & Alex., 2002; Sampson S, et. al, 2008).

A significant clinical healing can be seen 1-2 weeks after PRP implementation. For maximum effect 3-4 applications should be made with an interval of 2-3 weeks (Sclafani, 2011; Anthony & Sclafani, 2009).

PRP applications must be avoided to use on the patients who have thrombocytopenic hypofibrinogenemia, liver diseases and malignancy; on acute and chronic infections, on pregnant and breastfeed mothers, on the people who have autoimmune disease and sensitive to blood and blood products. Since applications built for injection; injectors connected to the skin of the entry techniques can be seen as some local side effects. (Azzena et al., 2008).

There will be non allergic reactions on PRP implementation because of using patient's own blood. There may be have feeling of stretched skin, and it will be gone in 1-2 hours without a treatment. The side effect risk of PRP implementation is very low, because of using the patient's own platelets.

Because of it is implemented by injection, some local side effects can be seen on injected area due to injection technique. Only, small amount of ecchymoses can be seen on injection area

and it will be healed in a couple of days without a treatment. If there will be presentation of erythema, it will be gone in 30-40 minutes without a treatment.

As a result, PRP is concerned about alternative treatment method because of it is a practical method, has no serious side effects, doesn't present widespread scar tissue, doesn't cause malign transformations, can be found easily and can be obtained in a cheap way (Kazemi et. al., 2010).

### **Conflict of Interest**

Authors declare no conflict of interest.

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