

REVIEW

## *Platelet-rich plasma (PRP) and its role in sports-related injuries*

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### ABSTRACT

PRP is obtained by getting autologous blood-containing platelets and these platelets have a significant impact on the process of healing an injury and tissue regeneration. Therefore, it is used in various fields including the treatment phases of sports-related injuries. In the search for scientific literature related to this review, the US National Library of Medicine (PubMed) used MEDLINE and SportDiscus data and the terms “platelet-rich plasma”, “sports-related injuries”, and “orthopedics” were used. The relevant literature has also taken its source from the research of relevant articles from reference lists derived from data studies.

PRP is accepted as a prominent treatment method in various fields, and it is proven to be safe and requires little effort. Since it has many advantages and benefits, PRP is utilized in the treatment of sports-related injuries and the field of orthopedics as well. Studies show that PRP has various benefits for the healing processes of wounds and injuries. It accelerates the period that injuries require to heal and therefore, it is getting more and more popular to use PRP in sports-related injuries.

*Keywords:* platelet-rich plasma, sports-related injuries, orthopedics

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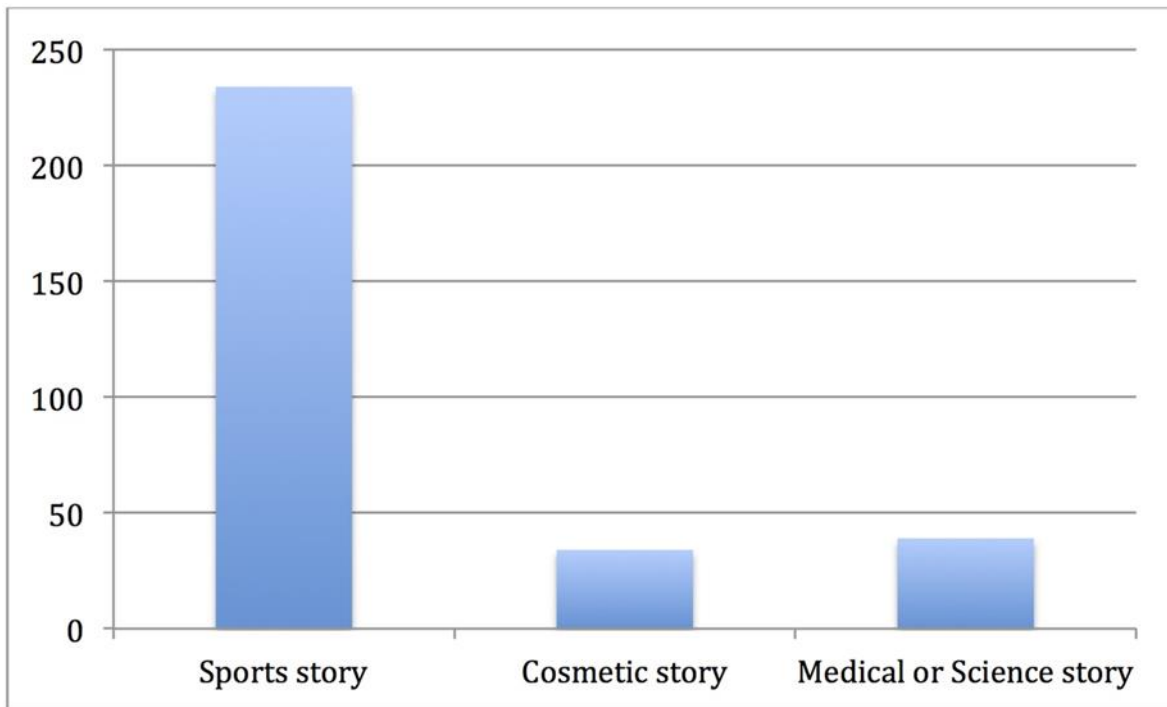
Onur Oral, George N. Nomikos, Evangelia Stavropoulou, Pınar Tatlibal. Platelet-rich plasma (PRP) and its role in sports-related injuries. *Scientific Chronicles* 2023; 28(1): 12-19

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### INTRODUCTION

Nowadays, many new methods are being discovered in the field of healthcare and medicine to apply appropriate treatments for various health problems. One of these new methods is platelet-rich plasma (PRP) application. PRP is obtained by getting autologous blood containing platelets and these platelets, which exist in autologous blood at higher concentrations than normal, have a

significant impact on the process of healing of an injury and tissue regeneration [1,2] as they secrete certain growth factors [3]. Therefore, PRP is utilized in various fields as a method of treatment such as periodontal and oral problems [4,5], orthopedic and trauma surgeries [6,7], surgeries of cosmetic and plastic [8], burns [9], sport-related injuries such as acute hamstring [10,11] and so forth. In a study as stated in Figure 1, meanwhile, it is found that articles in which the use of PRP is mentioned are mostly associated with stories related to sports,



**Figure 1.** Chart of the subject of the articles in which PRP is mentioned. Articles related to sports stories are over 200, whereas cosmetic stories and medical or science stories referring to PRP are below 50 [12].

which accounts for 76.4% of the total article number [12]. This study shows us the role and importance of PRP in sports as a treatment method for various health issues that athletes experience.

The autologous PRP was utilized by Ferrari et al. in 1987 for the first time after an open-heart surgery so that they could prevent extreme transfusion of homologous blood products [13]. Since then, it has been attracting attention and new studies have been conducted for the use of PRP in different fields.

As it is stated before, platelets are the key elements of PRP and they stimulate the mitogenesis of cells, which are capable of healing, and angiogenesis in a tissue [14]. Generally, the platelet count of an adult varies

between 150,000 and 350,000/mL but studies show that either this number should be 1 million platelets per mL in a concentration or it should be 4-7 times more than a usual count in a baseline so that the application of PRP may provide the intended benefits. One of these benefits is also an improved healing process, which is supported by the elevated number of growth factors induced by the great number of platelets [14,15]. Some of the growth factors that PRP contains are platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF- $\beta$ ), vascular endothelial growth factor (VEGF), and epithelial growth factor (EGF) [3,16]. Also, PRP embodies some adhesion molecules in its form such as fibrin, fibronectin, and vitronectin, which help bone formation [3]. In the table below, the growth factors that PRP contains are

**Table 1.** Chart for growth factors that PRP contains and the average concentrations it involves. The benefits and effects of these growth factors are also demonstrated [17].

| Growth Factor* | Effect   | PRP concentration (SD)   |
|----------------|--|--|
| PDGF           | Macrophage activation and angiogenesis<br>Fibroblast chemotaxis and proliferative activity<br>Enhances collagen synthesis<br>Enhances the proliferation of bone cells  | $\alpha\beta$ : 117.5 ng/ml (63.4)<br>$\beta\beta$ : 9.9 ng/ml (7.5) |
| TGF- $\beta$   | Enhances the proliferative activity of fibroblasts<br>Stimulates biosynthesis of type I collagen and fibronectin<br>Induces deposition of bone matrix<br>Inhibits osteoclast formation and bone resorption                     | $\beta$ 1: 169.9 ng/ml (84.5)<br>$\beta$ 2: 0.4 ng/ml (0.3)          |
| IGF-I          | Chemotactic for fibroblasts and stimulates protein synthesis<br>Enhances bone formation by proliferation and differentiation of osteoblasts  | 84.2 ng/ml (23.6)  |
| PDEGF          | Promotes wound healing by stimulating the proliferation of keratinocytes and dermal fibroblasts  | 470 pg/ml (320)  |
| PDAF           | Induces vascularisation by stimulating vascular endothelial cells  |  |
| PF-4           | Stimulates the initial influx of neutrophils into wounds<br>A chemoattractant for fibroblasts<br>A potent antiheparin agent  | 0.189 nmol/ml (0.07)   |
| EGF            | Cellular proliferation<br>Differentiation of epithelial cells  | 51 pmol/l (5)  |
| VEGF           | Angiogenesis<br>Migration and mitosis of endothelial cells<br>Creation of blood vessel lumen<br>Creates fenestrations<br>Chemotactic for macrophages and granulocytes<br>Vasodilation (indirectly by release of nitrous oxide) | 76 to 854 pg/ml  |

\* PDGF, platelet-derived growth factor; TGF, transforming growth factor; IGF, insulin-like growth factor; PDEGF, platelet-derived endothelial growth factor; PDAF, platelet-derived angiogenesis factor; PF-4, platelet factor 4; EGF, endothelial growth factor; VEGF, vascular endothelial growth factor.

explained and it shows the average concentrations and benefits of growth factors [17] (Table 1).

Furthermore, PRP is accepted as an application, which requires little effort during the phase of production [5,8], which makes it more in demand. To solve PRP, generally, a patient's blood is taken from the median cubital vein [14]. Then, the application of centrifugation is implemented so that first the plasma is separated from red blood cells and second centrifugation isolates PRP from platelet-poor plasma [18]. Also, an autologous PRP is safe to use in terms of transmissible diseases such as HIV, hepatitis, and so forth [19-21]. Another advantage of PRP is that it may be obtained both in hospital and office environments as long as appropriate and useful systems are utilized [8,15,22].

Apart from its advantages in terms of its production, the environment in which it is provided, and so forth, it would not be wrong to state that PRP is also considered to be effective on sports injuries and in the field of orthopedics as well. For instance, one of the injury types that athletes often experience is an acute muscle injury, which leads to them missing training and competitions [23,24]. Recent studies point out that PRP stimulates recovery phases of muscle injury when mixed with substances containing the neutralizing effect of TFG-b1 [25]. Also, it is possible to indicate from the studies conducted that in the treatment of chronic tendon injuries such as elbow, Achilles, and patella, PRP provides various benefits [26,27]. Besides, its utilization for acute hamstring injuries, which comprise

approximately 29% of all sports injuries is considered to be beneficial [10,11]. Also, some of the common injuries, in which PRP may provide advantages during treatment phases in the field of orthopedics are patellar tendinopathy, also known as "jumpers knee" and one of the most common injuries that athletes experience [28], Achilles tendinopathy [29], rotator cuff repair [30] and knee osteoarthritis [31-33].

## **DISCUSSION**

According to the data from the United States, it is estimated that PRP is used as a treatment method for about 86,000 athletes every year [1], which is a great number and proves that the demand for PRP in the field of sports medicine is increasing day by day.

Besides, in a study conducted by Smyth et al. related to the use of PRP for osteoarthritis, based on 15 of the 21 in vivo and in vitro studies, it is found that PRP not only helps the reproduction of chondrocytes but also boosts proteoglycan production. Also, it improves the deposition capacity of type II collagen [34].

As it is stated before, PRP also contributes to bone formation and in this regard, a few studies have been carried out to point out the benefits of PRP. For instance, to show the impact of PRP on bone healing after an orthopedic trauma, some studies have also been conducted [14,35]. Similar to these studies, in research, Kitoh et al. implemented PRP and bone marrow cells (BMCs) for osteogenesis distraction on three patients, and callus formation was detected between the 34th and

47th days in all patients. Therefore, it was decided that a distraction of 1.55 mm would be implemented each day. As a result, bone formation was accelerated [36].

Also, various studies have been conducted regarding the use of PRP and its benefits on tendons as well. Recently, it has been used as a treatment method for patients suffering from lateral epicondylitis. For example, in a study, encouraging and critical changes were observed in patients with a single injection and no complications were reported [37]. Also, in a study carried out by Sánchez et al. on the relation between PRP and its impact on athletes suffering from ruptured tendo Achillis. A solution that has abundant growth factors (PRGF) was prepared for six athletes and when this application was compared with a group that had undergone surgeries. As a result, the group with PRGF experienced a better recovery process and attended training in a shorter period. Also, there was no complication observed [38].

On patients suffering from diabetic foot ulcers, a randomized and controlled study was carried out by Driver et al. to evaluate and compare the impact of autologous PRP gel on the normal saline gel. This study lasted for 12 weeks and 72 patients with type 1 and type 2 diabetes were involved. Their ages varied between 18 and 95 and they were divided into

two groups based on the type of gel that they received. Meanwhile, 32 patients were removed from the study as they did not obey protocol and get appropriate treatment. Despite this, the study was completed and it was found that the wounds of the group with PRP gel had been healed at the rate of 68.4%, while this rate was 42.9% in the other group with saline gel. Also, it was found that the wounds of the patients in the PRP group were healed in a shorter period when compared with the other group [39].

## CONCLUSION

Regarding the studies conducted and data acquired, it is possible to express that PRP has become a prominent treatment method in recent years, which may be utilized in a range of fields. Therefore, it has been attracting attention and new studies have also been conducted regarding its use in various fields. Also, the fact that it is obtained with little effort and in both hospital and office environments with appropriate authority paves the way for its accessibility. Moreover, it is proved by reports and studies that PRP is safe to apply since there is no risk of transmissible diseases. Besides, since the benefits of PRP application are also proved by many studies conducted, the use of it in the treatment of sports-related injuries and the field of orthopedics is also getting more and more popular.

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