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## Efficacy of autologous platelet rich plasma injection in plantar fasciitis and tennis elbow

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### Abstract

#### Aims and Objectives

1. To study the efficacy of autologous platelet rich plasma in plantar fasciitis and tennis elbow.
2. To compare the outcome of autologous platelet rich plasma injections between plantar fasciitis and tennis elbow patients.

**Materials and Methods:** This is a prospective trial involving the patients in the department of orthopedics, Melmaruvathur Adhiparasakthi institute of medical college science hospital and Research Institute, GST road, Melmaruvathur, Tamil Nadu, India.

Prior consent was obtained from ethics committee for research in human beings before the study.

A total of 70 patients were included in this study. Out of 70 patients 25 patients had tennis elbow and 45 patients had plantar fasciitis. All the patients were selected based on the inclusion and exclusion criteria described. All the patients underwent same method of treatment. All the patients were assessed based on the numerical pain scoring system which will be described.

#### Inclusion Criteria

1. Patients with clinically diagnosed tennis elbow or plantar fasciitis
2. Patients should have minimum three months duration of symptoms
3. Patients should underwent conservative treatment for a minimum period of three months
4. Patients should have pain score greater than seven at the time of PRP injection.
5. Patients should not had a local steroid injection in last 2 months
6. Both sexes- males and female
7. Age- 18 years and above

#### Exclusion Criteria

1. Less than 3 month duration of tennis elbow and plantar fasciitis
2. Patients without any trial of conservative treatment
3. Recent local steroid injection.
4. Infection or ulcer at the injection site
5. Rheumatoid arthritis
6. Sero negative spondylo arthritis
7. Pregnant ladies
8. Patients younger than 18 years
9. Suspicion of diagnosis.

**Keywords:** PRP, plantar fasciitis, Tennis elbow, Bone grafting

### Introduction

Over the past 3 decades, platelet rich plasma has gained increased importance in various medical fields, including orthopedics. Several studies have shown the use of platelet rich plasma in management of soft tissue and bony injuries. Recently, platelet plasma has been used for cartilage regeneration, chronic enthesopathies like tennis elbow, plantar fasciitis, and in the field of sports medicine.

The majority of orthopedic applications of platelet rich plasma will fall into 4 categories-

1. Chronic tendinopathies
2. Acute ligamentous injuries
3. Muscle injuries
4. Augmentation of other treatment modalities like bone grafting

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Platelet rich plasma had a biological healing capacity. Platelet rich plasma helps in healing both tennis elbow and plantar fasciitis and recurrence rate will be low. In this study we used intralesional injection of autologous platelet rich plasma for the treatment of chronic tennis elbow and plantar fasciitis.

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**Clinical diagnosis**

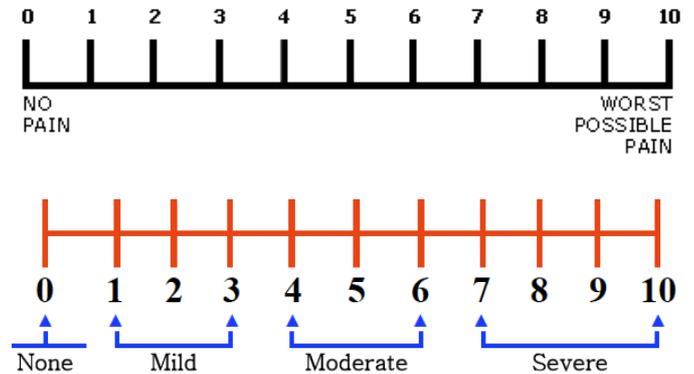
Diagnosis of tennis elbow was made when patient had pain in the lateral aspect of elbow joint. The pain would aggravate on wrist dorsiflexion. On examination the patient would have localized tenderness over lateral epicondyle.

Diagnosis of plantar fasciitis was made when patient had heel pain. The pain was worse in the morning. Patient had localized tenderness over the insertion of plantar fascia over the calcaneum.

**Numerical pain score**

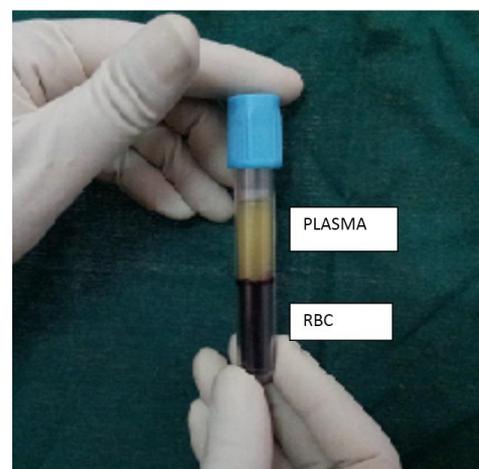
Numerical pain score is a subjective assessment of pain, where the patient rates the intensity of the pain perceived. Score Zero refers to no pain. Score 10 refers to the worst pain possible.

On the basis of numerical pain score, intensity of pain was divided in to mild, moderate and severe. Score zero to three was taken as mild, four to six as moderate and seven to ten as severe pain.



**Preparation of PRP**

Platelet rich plasma was prepared using double spin centrifugation method of Augustus D *et al.* [25]. 20 ml of venous blood is drawn from cubital vein. The blood is immediately transferred into six 2.7ml vacutainers prefilled with acid citrate dextrose. 2.7 ml Acid citrate dextrose containing vacutainers are readily available in hospital. All the containers are filled till the markings on the vacutainers. The vacutainers are then placed in the slot available in the centrifugation machine in such a way that they are counter balanced. The initial centrifuge was done at 1500 rotations per minute for three minutes. This separates the blood into two layers. RBC rich at the bottom and plasma along with the platelets are at the top (figure 1). The top layer is then transferred to fresh vacutainers using a long 18 G needle and syringe. The vacutainers are now again centrifuged at 2500 rotations per minute for three minutes. This separates the column of plasma to platelet rich at the bottom and platelet poor at the top. Using a long 18 G the top half column which is platelet poor is discarded. The platelet rich plasma at the bottom is now collected from the vacutainers and is now ready for use.



**Fig 1**

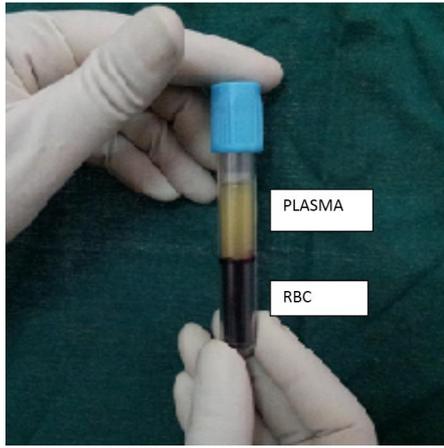


Fig 2

After the preparation of PRP, the PRP is assessed for cell counts. The platelet count in the platelet rich plasma range from 2.1 to 5.9 lakhs.

**Technique of infiltration**

Most tender point was palpated and marked using a skin (figure 2) marker and area was prepared for injection. Under aseptic precaution using a 21 and 1 1/2 inch needle, 1ml PRP is injected initially over the maximum tender point and needle is partially withdrawn and multiple punctures are made in the surrounding tissue (peppering technique). The remaining 1 ml of platelet rich plasma was injected in surrounding tissue.

**Platelet activation**

According to Kenneth s lee *et al.* needling of surrounding tissue will activate the platelets by the release of thrombin from the fresh bleeding. We used this technique for platelet activation [19].

**Follow up**

Patients were followed up for 6 months. A telephonic follow up was done at second day after injection to find out any adverse reactions. Follow ups was done at 1, 2, 4, 6 months. Patients were assessed subjectively using the numerical pain score.

**Results and analysis**

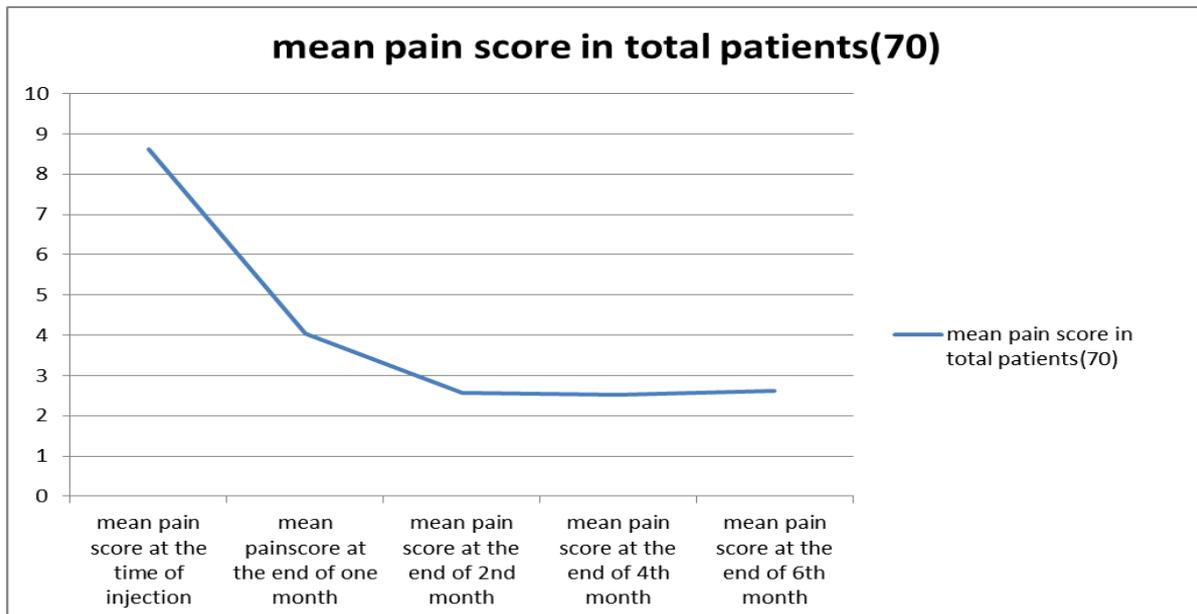
Patients were analyzed for pain relief subjectively at 1, 2, 4 and 6 months. The results are given below.

**Mean pain score**

Pain score was assessed at the time of injection. The mean pain score of all the patients was 8.614. The mean pain score at 1,2,4,6 months was 4.028, 2.57, 2.52 and 2.62 respectively. When individually analyzed mean pain score for plantar fasciitis at 0, 1,2,4,6 months was 8.68, 3.68, 2.155, 2, 2.13 respectively. similarly mean pain score for tennis elbow at 0,1,2,4,6 months was 8,08,4.36,3.56,3.48,3.6 respectively. From the above data it can be concluded that patient get maximum relief of symptoms at two months and is sustained till at least 6 months (chart no 1).

Chart 1: Mean pain score

patients	Median pain score at time of injection	Median pain score at 1 month follow up	Median pain score at 2 month follow up	Median pain score at 4 month follow up	Median pain score at 6 month follow up
Total(70)	8.614	4.028	2.57	2.52	2.62
Plantar fasciitis(45)	8.68	3.68	2.155	2.00	2.13
Tennis elbow(25)	8.08	4.36	3.56	3.48	3.60



Graph 1: mean pain score

**Duration of symptoms**

Out of total 70 patients 59 patients had symptoms of less than one year duration. 11 patients had pain for more than one year

before coming here for treatment. All patients had conservative treatment for at least three months (chart no 2).

**Chart 2:** Duration of symptoms

	3-6 Months	7-12 Months	More Than 1 Year
Total Patients(70)	35	24	11
Plantar Fasciitis(45)	24	18	3
Tennis Elbow(25)	11	6	8

**Duration of symptoms and pain relief**

Analysis was done based on the duration of symptoms and ultimate pain relief. 16 out of the 35 patients with pain of less than 6 months, 9 out of 24 patients with duration of symptoms between 6-12 months and 5 out of 11 with symptoms of greater than one year had complete relief of pain. 2 out of 35

patients with pain less than 6 months, 4 out of 24 patients with pain for 6-12 months, and 2 out of 11 with pain greater than 1 year duration had no improvement of symptoms at six months (chart no-3). Duration of symptoms had no significant correlation with the clinical outcome after injection.

**Chart 3:** Pain Reduction Related to duration of symptoms in total Patients

	100% Pain Relief	50-99% Pain Relief	Less Than 50% Pain Relief	0% Pain Relief
3-6 Months	16(22.86%)	13(18.57%)	4(5.71%)	2(2.86%)
7-12 Months	9(12.86%)	9(12.86%)	2(2.86%)	4(5.71%)
More Than 1 Year	5(7.14%)	2(2.86%)	2(2.86%)	2(2.86%)

**Statistical analysis**

SPS software system was used to do statistical analysis by comparing the results of 1,2,4,6 months. P value for the test was taken as 0.05.

Group Statistics								
	Number of patients		Mean percentage reduction of pain		Std. Deviation		Std. Error Mean	
	Plantar fasciitis	Tennis elbow	Plantar fasciitis	Tennis elbow	Plantar fasciitis	Tennis elbow	Plantar fasciitis	Tennis elbow
1 month	45	25	57.6544	47.5000	33.18452	36.38205	4.94686	7.27641
2 month	45	25	75.6796	57.6108	31.88905	37.63747	4.75374	7.52749
4 month	45	25	77.4080	58.6108	30.10367	38.44225	4.48759	7.68845
6 month	45	25	75.8647	57.2776	32.22099	37.92296	4.80322	7.58459

Independent Samples Test						
	Equal variances assumed					
	Levene's Test for Equality of Variances			t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)	
1 month	.683	.411	1.185	68	.240	
2 month	1.483	.227	2.129	68	.037	
4 month	3.389	.070	2.264	68	.027	
6 month	1.762	.189	2.170	68	.034	

The mean pain score at 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> month found to significantly equal but pain score at 1 month was not significantly equal.

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	1 month	54.0279	70	34.44765	4.11728
	2 month	69.2264	70	34.88885	4.17002
Pair 2	2 month	69.2264	70	34.88885	4.17002
	4 month	70.6947	70	34.26667	4.09565
Pair 3	4 month	70.6947	70	34.26667	4.09565
	6 month	69.2264	70	35.25239	4.21347
Pair 4	2 month	69.2264	70	34.88885	4.17002
	6 month	69.2264	70	35.25239	4.21347

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	1 month& 2 month	70	.765	.000
Pair 2	2 month & 4 month	70	.983	.000

Paired Samples Test									
		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	1 month - 2 month	-15.1986	23.75019	2.83869	-20.8616	-9.5355	-5.354	69	.000
Pair 2	2 month - 4 month	-1.4683	6.39264	.76407	-2.9926	.0560	-1.922	69	.059
Pair 3	4 month - 6 month	1.4683	9.34823	1.11733	-.7607	3.6973	1.314	69	.193
Pair 4	2 month - 6 month	.0000	13.77992	1.64702	-3.2857	3.2857	.000	69	1.000

When comparing the significance of pain reduction it was found that there was significant pain reduction till two months and further the reduction was not significant. This indicates there was not much reduction of pain after 2<sup>nd</sup> month.

## Discussion

Platelet contains biologically active substance for blood clotting, such as coagulation factors, adhesive proteins and protease inhibitors. Platelets were also known to release growth factors like TGF –beta 1, CGF, VEGF, and PDGF. These growth factors are released once the platelets were activated. These growth factors initiates the process of tissue healing by cellular proliferation and differentiation, chemo taxis, tissue debris removal, angiogenesis, and extra cellular matrix formation [5]. These properties of tissue healing by platelets are used in treating degenerative enthasopathies like plantar fasciitis and tennis elbow by direct local injection of autologous platelet rich concentrate.

Various techniques have been described for the preparation of autologous platelet rich plasma. They differ in duration and speed of centrifugation. The containers used for platelet rich plasma preparation also differ to minimize the direct handling of blood. The volume of platelet rich plasma usually comes about 10 percent of the whole blood used. Alsousou *et al.* used a gps system for preparation of PRP. The PRP volume of about 5 ml was collected following 12 minutes of rotations at 3200 rpm [5]. Augustus D *et al.* used a double centrifugation method which separates blood first in to plasma and RBC. The plasma formed was separated again in to platelet rich plasma and platelet poor plasma by second centrifugation [23]. In this study Augustus D *et al.* method of double centrifugation was used. By repeated trial and error method we standardized the procedure of preparation of platelet rich plasma.

Platelet rich plasma is also known as platelet rich concentrate, autologous platelet gel or platelet releasate [15]. platelet rich plasma is defined as autologous blood with a concentration of platelets above the base line values. The platelet count in our samples ranged from two to six lakhs per cc. Hall m.p. *et al.* described platelet rich plasma contains a two to eight fold increase in platelet concentration and 1-25 fold increase in growth factor concentration [14]. According to Marx R E *et al.* in an article “what is prp and what is not PRP?” described that at least 10 lakhs of platelet per ml in five ml of plasma, will be associated with enhancement of healing. Alsousou J *et al* in a review article described a concentration of five times the normal count as working definition of PRP [5].

Growth factor concentration can be assessed by ELISA. Concentration of growth factors also depends on the method of preparation of prp. Augustus *et al.* found that growth factors like HGF, IGF-1, and PDGF will be high in single centrifugation than in double centrifugation [23]. Since the assay of growth factors was not cost effective we did not do assay of growth factors.

PRP can be divided in to low WBC PRP and high WBC PRP depending on WBC concentration. Augustus D *et al.* found that WBC count is low in platelet poor plasma and high in

platelet rich plasma [23]. They found that there were no significant difference in WBC cell types in platelet poor plasma and platelet rich plasma [23]. The concentration of WBC in PRP was a subject of debate. Some authors recommended avoiding exposure of WBC to tissues so that inflammatory reaction may decrease. Bielecki T M *et al.* support the WBC presence as it has antibacterial actions and increase in growth factor release [38].

Platelets in PRP get activated once they get released from circulation. Different techniques have been used by various authors for platelet activation. Kenneth s lee *et al.* described that needle prick at the time of injection will induce bleeding which will provide the clotting factor thrombin need for activating platelets. Addition of substances like bovine thrombin, calcium chloride and type 1 collagen for activating platelets [18]. In this study Kenneth s lee *et al.* technique of needling was used for platelet activation [19].

Most of the authors used similar technique of infiltration for PRP treatment. Keith s Hetchman *et al*, Joost. C. Peerbooms *et al*, Ertugrul Aksahin *et al*, Ehab Mohammed selem Ragab *et al*, used similar technique. They palpated the point of maximum tenderness and injected by single skin portal and five to six penetrations in surrounding tissues. This technique was known as peppering technique. In this study we used same technique for injecting platelet rich plasma in plantar fasciitis and Tennis elbow patients.

This was a prospective trial by study design conducted on 70 patients which includes 45 patients with plantar fasciitis and 25 patients with tennis elbow. Both groups of patients were selected based on the inclusion criteria and exclusion criteria described. Patients having chronic inflammatory conditions like rheumatoid arthritis are excluded from the study. Assessment of progression was done based on numerical pain scoring system.

The following are some studies, investigated the efficacy of PRP on tennis elbow and plantar fasciitis. The studies on plantar Fasciitis were conducted by Joost c Peerbooms *et al.* [22], Ehab Mohammed selem Ragab *et al.* [1], Ertugrul Aksahin *et al.* [2] etc. Joost c peerbooms *et al.* done a randomized multicenter trial with a study population of 120 patients above eighteen years. They compared the results with steroid injection by randomly selecting patients for PRP and steroid injections. The outcome was measured based on pain and functional scores. Ertugrul Aksahin *et al.* did a similar study by comparing the effect of PRP and steroid injection on plantar fasciitis. The study population was 60 with 30 each patients got PRP and steroid injections. Ehab Mohamed selem Ragab *et al.* did a study on 25 plantar fasciitis patients by injecting PRP. The outcome was measured by comparing preinjection and post injection visual analog score and plantar fascia thickness by ultrasound [1]. There was no control group in his study

Following are some studies conducted on tennis elbow patients 1. Christos Thanases *et al.* by comparing PRP to whole blood for tennis elbow [14]. 2. Samuel A Taylor *et al.* on 100 tennis elbow patients compared between PRP and steroid injection [11]. 3. Keith s Hetchman *et al.* on 31 elbows which

was not responded for conservative treatment by single PRP injection [13].

While comparing the results at 1, 2, 4, 6 months followup, it was found that patients got relief at one month. However the maximum relief of symptoms was at two months. The results obtained at two months sustained till the end of the study except in two patients. One patient with tennis elbow and one patient with plantar fasciitis had recurrence of symptoms at four months. While considering the results in plantar fasciitis and tennis elbow patients separately it was found that results of plantar fasciitis were better than tennis elbow. 82 percent of plantar fasciitis patients and 68 percent of tennis elbow patients had more than 50 percent of pain relief at six months. No patients had repeat injections. The above results were comparable with Ertugral Aksahin *et al.* and Christos Thanases *et al.* study [2, 14]. The study of Christos Thanases *et al.* in tennis elbow the mean injection score was reduced from 6.1 to 2.35 at the end of 6 weeks, at 3 months 1.9 and 6 months 1.7. In a study by Ertugral Aksahin *et al.* on plantar fasciitis patients the mean pain score was reduced from 7.33 to 5.6 at 3 weeks and 3.9 at 6 months.

The difference between 1, 2, 4 and 6 months pain reduction were tested for significance by paired T – test using SPS system and found that there was no significant difference in pain reduction between 2 months and 4 months, 2 months and 6 months, 4 months and 6 months scores. But there was significant difference in pain score in 1 and 2 months. By testing independent samples T-test using equal variances assumed found that 2 months, 4 months and 6 months pain reduction was significantly equal in all groups.

Duration of symptoms suggests the chronic nature of disease. In this study only 11 out of 70 patients had symptoms more than one year duration. 7 patients out of 11 had more than fifty percent pain relief compared to 18 patients out of 59 with less than one year duration. No studies are available to compare the chronicity of disease and outcome after PRP injection.

#### Limitations of the study

1. Both plantar fasciitis and tennis elbow patients were given similar treatment and there were no control group to compare the outcome of autologous PRP injection.
2. The sample size was 70. Out of 70 patients 45 had plantar fasciitis and 25 had tennis elbow. There was no similarity in sample size between the two groups.

#### Summary

Plantar fasciitis and tennis elbow are two diseases having similar pathology and both are considered as degenerative tendinopathies. Repeated micro trauma is the major etiology of these two diseases. Autologous platelet rich plasma injections are becoming more popular in the treatment of enthesopathies like plantar fasciitis and tennis elbow. The growth factors in platelet rich plasma cause tissue healing. We conducted a study by intralesional autologous platelet rich plasma injections in chronic plantar fasciitis and tennis elbow patients. This was a prospective study conducted on total 70 patients, out of which 45 patients had plantar fasciitis and 25 patients had tennis elbow. Patients were selected based on the inclusion and exclusion criteria described. All the patients had similar form of treatment given that is single intralesional autologous PRP injection by pepping technique. Platelet rich plasma was prepared by a double centrifugation method initially at 1500 rotations per minute for 3 minutes and later at 2500 rotations per minute for 3 minutes. 2ml of

PRP was obtained from 20ml of blood. This PRP was analyzed for cell count. The initial and 1,2,4,6 month's numerical pain score was recorded and analyzed. It was found that 77 percent of patients had significant relief of pain at two months which continued till the end of study. Pain relief in plantar fasciitis and tennis elbow patients were analyzed separately and found 82 percent of plantar fasciitis patients and 68 percent of tennis elbow patients had significant pain relief at two months and it continued till the end of study. Duration of symptoms to pain relief were analyzed and found no correlation. Finally it was concluded that intralesional autologous platelet rich plasma injection was safe and useful in the treatment of chronic plantar fasciitis and tennis elbow and plantar fasciitis benefit better than tennis elbow with maximum benefit observed at 2 months.

#### Conclusion

Intralesional autologous PRP is a safe and useful modality of treatment in the treatment of chronic plantar fasciitis and tennis elbow.

Following PRP injection results of plantar fasciitis is better than tennis elbow

Maximum benefit after PRP injection was observed at 2 months.

More trails are required to optimize the technique for separating platelet rich plasma.

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