

Autologous platelet-rich plasma injection in tennis elbow and plantar fasciitis

S.K.Venkatesh Gupta, MS (Ortho) Prof and HOD and Divya Bandari, Post Graduate

Department of Orthopaedics, Mamata Medical College/General Hospital, Khammam, Telangana, India

ABSTRACT

Background:

The introduction of platelet rich plasma (PRP) as a possible adjunct to conservative and operative treatment has motivated significant research into this topic. PRP is a set of autologous platelet products used to accelerate recovery from injury by bringing to the site of injury a set of molecules that will accelerate the functional recovery of the tissue by trying to regenerate it rather than merely repair with scar tissue. In this prospective study, we evaluate the results of PRP in tennis elbow and plantar fasciitis.

Methods:

During October 2013 to March 2015, 100 patients, 60 with tennis elbow and 40 plantar fasciitis, who visited our center with failed conservative treatment were treated with PRP, and results were evaluated with VAS, DASH and FHSQ scores.

Results:

Among 60 patients with tennis elbow (24 males and 36 females) post-PRP injection significant differences were observed between VAS and DASH score at baseline and after 4 wk and 8 wk ($P < 0.001$). Among 40 patients with plantar fasciitis (16 males and 24 females) post-PRP injection significant results were observed between VAS and FHSQ scores at baseline and after 4 wk and 8 wk ($P < 0.001$).

Conclusions:

PRP when given with proper care appears to be helpful in tennis elbow and plantar fasciitis. It is safe and a significant improvement has been observed in VAS and DASH scores for tennis elbow and VAS and FHSQ for plantar fasciitis.

Key Words

platelet rich plasma, plantar fasciitis, tennis elbow

promoted as an ideal autologous biological blood-derived product that can be exogenously applied to various tissues where it releases high concentrations of platelet-derived growth factors that enhance wound, bone, and tendon healing.² Platelets present in PRP function as a tissue sealant, initiating wound repair.³ Whereas fibrin matrix acts as a drug delivery system slowly releasing various platelet-derived bioactive factors⁴ such as vascular endothelial growth factor (VEGF), transforming growth factor (TGF)- β 1, insulin-like growth factor (IGF) and platelet derived growth factor (PDGF),^{5,6} PRP platelets are initially activated by thrombin and collagen, releasing growth factors that attract undifferentiated cells into the newly formed matrix and trigger cell division.⁷ PRP can inhibit cytokine release from macrophages, improving tissue healing and regeneration by limiting the inflammation,⁸ can promote new capillary growth,⁹ and can accelerate epithelialization⁴ in chronic wounds.

Platelet rich plasma has found its application in various orthopaedic conditions like tendinopathies (i.e., lateral epicondylitis,^{2,8,10-12} patellar tendinopathy,¹³⁻¹⁵ Achilles tendinopathy,^{16,17} shoulder impingement syndrome,¹⁸ rotator cuff tear,¹⁷ osteoarthritis knee,¹⁹⁻²¹ and avascular necrosis of femoral head).²² We have emphasized two conditions in this article, tennis elbow and plantar fasciitis.

Probably one of the most common overuse syndromes is related to excessive wrist extension and is commonly referred to as tennis elbow or lateral epicondylitis. It does not show signs of inflammation but rather angiofibroblastic degeneration and collagen disarray. On a histological level, light microscopy reveals both an excess of fibroblasts and blood vessels that are consistent with neo-angiogenesis.²³

Chronic plantar fasciitis is probably the most common cause of foot complaints, making up 11% to 15% of the midfoot and hindfoot symptoms, requiring professional care among adults.²⁴ The underlying condition that causes plantar fasciitis is a degenerative tissue condition that occurs near the site of origin of the plantar fascia at the medial tuberosity of the calcaneus.²⁵

MATERIALS AND METHODS

The protocol of this study has been approved by the relevant ethical committee related to our institution in which it was performed. All subjects gave full informed consent to participate in this study. During October 2013 to March 2015, 100 patients 60 diagnosed with tennis elbow and 40 diagnosed with plantar fasciitis, visiting our center with

INTRODUCTION

The introduction of platelet rich plasma (PRP) as a possible adjunct to conservative and operative treatment has motivated significant research into this topic.¹ PRP is

Financial Disclosure: The authors have no disclosures and report no conflicts of interest.

Correspondence to Divya Bandari, Post Graduation, Mamata Medical College, Khammam, Telangana, India

Tel: +917799578082; fax: +91 8742 234206;

e-mail: divi_bandari@yahoo.com.

1940-7041 Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.

failed conservative treatment involving a trial of non-steroidal antiinflammator drugs (NSAIDs) and physiotherapy were treated with PRP and results were evaluated with Visual Analog Score (VAS), Disability of Arm Shoulder and Hand (DASH), and Foot Health Status Questionnaire (FHSQ).

Clinical Assessment

Among 100 patients, 60 patients of both sexes and over the age of 18 yr diagnosed as having tennis elbow and 40 diagnosed as having plantar fasciitis were selected based on following:

Inclusion Criteria for Tennis Elbow

1. Pain and tenderness over the lateral aspect of the elbow.
2. One of the following tests being positive: wrist extension (Cozen's test), Mill's maneuver, jar lifting test, wringing test, broom, or stir frying test.

Inclusion Criteria for Plantar Fasciitis

1. Pain in the inferior aspect of heel that is usually worse with their first steps in the morning or after a period of inactivity (with maximal tenderness over the anteromedial aspect of the inferior heel).
2. Increased pain on passive dorsiflexion of foot.

Overall Exclusion Criteria

1. Patients with history of anemia (hemoglobin < 7.0 g/dL).
2. Thrombocytopenia (platelets $< 150 \times 10^3$ μ L).
3. Pregnancy.
4. Local malignancy.
5. Local corticosteroid injections for lateral epicondylitis in previous 1 mo.
6. Rheumatoid disease and previous surgery or elbow dislocation.
7. Diabetes mellitus.

In both tennis elbow and plantar fasciitis NSAID's were avoided for 1 wk before and after the procedure.

Method of Data Collection

Data were collected by verbal communication with patients, including their informed consent when the clinical examination was done. Blood investigations like complete blood picture (CBP), clotting time (CT), bleeding time (BT), and random blood sugar (RBS) were done. Written documentation of pain (VAS) and evaluation of limitation of function (DASH and FHSQ) was done before and after the procedure.

Preparation of PRP

Blood was drawn from the patient in a syringe (10 mL) preloaded with citrate phosphate dextrose (CPD) and later centrifuged in two spins. The first spin was at 1800 rpm for 15 min to separate erythrocytes and white blood cells from other blood components and a second spin was at 3500 rpm for 10 min for further concentration of platelets. About 2 to 3 mL of platelet rich plasma was pipetted out and injected into the affected site. In our study we found an increase of platelets to three to five times from baseline.

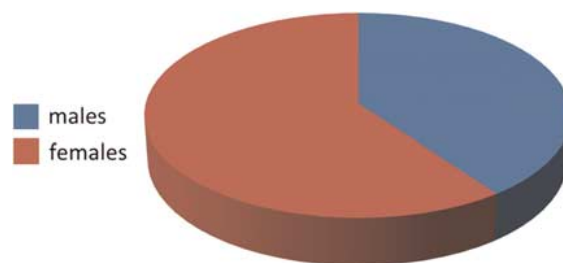


FIGURE 1. Tennis elbow participants (24 men and 36 women).

Procedure

The patient is placed supine and the site is palpated for maximal point of tenderness before giving a local anaesthetic. Under strict aseptic precautions local anaesthetic (2% xylocaine) followed by PRP is then injected into the affected site with a 18-gauge needle, and patient is advised to rest in the outpatient block for approximately 1 hr.

In cases of tennis elbow, the affected hand of the patient is immobilized in elastic crepe bandage and cuff and collar for 48 to 72 hr and the patient is strictly advised not to lift weights or participate in activities that involve wrist extension. In cases of plantar fasciitis, a crepe bandage is applied, and the patient is advised to use micro-cellulose rubber footwear and avoid sports and athletic activities for 48 to 72 hr. After 3 days, the crepe bandage is removed, and the patient is allowed to do daily activities. After the procedure, the patient is prescribed broad spectrum antibiotics (cephalosporins) for 3 days. All NSAIDs are strictly avoided for 7 days after the procedure.

Patients with tennis elbow and plantar fasciitis were evaluated at 1 mo, 2 mo, 3 mo, and 6 mo after injection using the VAS and DASH scores (for tennis elbow) and VAS and FHSQ scores (for plantar fasciitis). One month after injection of PRP, the patients were assessed and if there was no sign of improvement (less than 25% reduction in VAS, DASH AND FHSQ score),¹⁰ PRP injection was repeated twice with a gap of 1 mo between each. If no improvement was seen, after a period of 6 mo from the third injection, surgery was considered.

RESULTS

The mean age of the tennis elbow group was 40.5 ± 15.5 yr, and it included 24 men and 36 women and plantar fasciitis group was 42.5 ± 17.5 yr and it included 16 men and 24 women (Figures 1 and 2).

Table 1 compares the mean VAS (Figure 3) and DASH (Figure 4) scores in tennis elbow patients during their first visit and at 1 mo, 2 mo, and 3 mo. Highly significant results

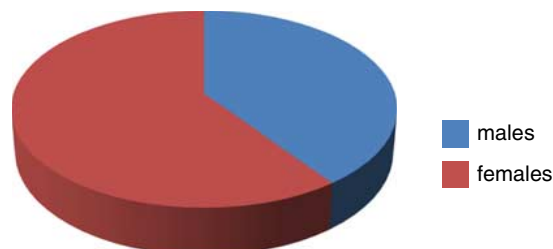


FIGURE 2. Plantar fasciitis participants (16 men and 24 women).

TABLE 1. Follow-up in patients with tennis elbow

Tennis elbow	1 st Visit (at the time of injury)	2 nd Visit (1 st month)	P value	3 rd Visit (2 nd month)	P value	4 th Visit (3 rd month)	P value
VAS	8.1 ± 0.77	3.8 ± 1.23	< 0.0037	3.05 ± 1.3	< 0.001	2.9 ± 1.4	< 0.0015
DASH	72 ± 6.5	36.2 ± 9.4	< 0.0019	33.3 ± 6.6	< 0.001	33.6 ± 9.5	< 0.001

Dash, Disability of the Arm, Shoulder and Hand; VAS, visual analog scale.

were observed between the scores at first visit and later visits, i.e., 4 wk and after 8 wk ($P < 0.001$).

Table 2 compares the mean VAS (Figure 3) and FHSQ (Figure 4) scores in plantar fasciitis during the first visit and at 1 mo, 2 mo, and 3 mo. Highly significant results were observed between the scores at first visit and later visits, i.e. 4 wk and 8 wk ($P < 0.001$).

There were four cases of tennis elbow and two cases of plantar fasciitis that were not successful after 1 mo of injection. Out of these, two patients with tennis elbow and one with plantar fasciitis injection had repeated injections and results were successful. The other three patients did not agree to have a second injection.

DISCUSSION

The current study strongly suggests that local injection of PRP is a novel form of treatment that provides significant relief of pain and improvement in function in both tennis elbow and plantar fasciitis. Moreover, it is possibly a safer option for patients than steroid use and surgery. The proposed mechanism of action of autologous PRP is improvement of early neotendon properties²⁶ and improvement of tissue healing by enhancing cellular chemotaxis, proliferation and differentiation, removal of tissue debris, angiogenesis and laying of extracellular matrix.²⁷

Relative to tennis elbow, our results are similar to those described by Mishra and Pavelko²⁸ who reported a significant

improvement of symptoms after 8 wk in 60% of the patients treated with PRP. At the end of 6 mo, patients treated with PRP noted 81% improvement in their VAS pain scores ($P = 0.0001$). Our results also are in agreement with that observed by Peerbooms *et al.*¹⁰ who reported that 24 of the 49 patients (49%) in the corticosteroid group and 37 of the 51 patients (73%) in the PRP group were successful ($P < 0.001$). Furthermore, in their study based on improvement on the DASH scores, 25 of the 49 patients (51%) in the corticosteroid group and 37 of the 51 patients (73%) in the PRP group were successful ($P = 0.005$); both these studies offer encouraging results of an alternative minimally invasive treatment that addresses the pathophysiology of tennis elbow for which traditional nonsurgical modalities failed.

In our study, we observed highly significant differences between VAS and DASH scores before and after injection ($P < 0.001$); after 4 to 8 wk after injection, 75% patients had excellent VAS score improvement (> 50% reduction) and around 62% had reduction of DASH score (> 50%).

Relative to plantar fasciitis, Martinelli *et al.*²⁹ demonstrated at 12 mo follow-up excellent results in 9 of 14 (64.3%) patients with chronic plantar fasciitis who received three injections of PRP into the plantar fascia, good results in two (14.3%), acceptable results in two (14.3%), and a poor result in one (7.1%) according to the Roles and Maudsley score. VAS for pain was significantly decreased from 7.1 ± 1.1 before treatment to 1.9 ± 1.5 at the last follow-up ($P < 0.01$)²⁹ In another study conducted by Barret *et al.*³⁰ in which PRP

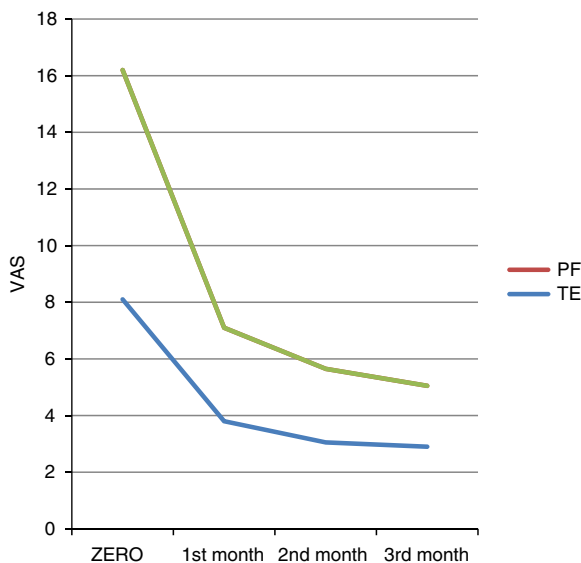


FIGURE 3. Graph showing improvement in visual analog scale in tennis elbow and plantar fasciitis.

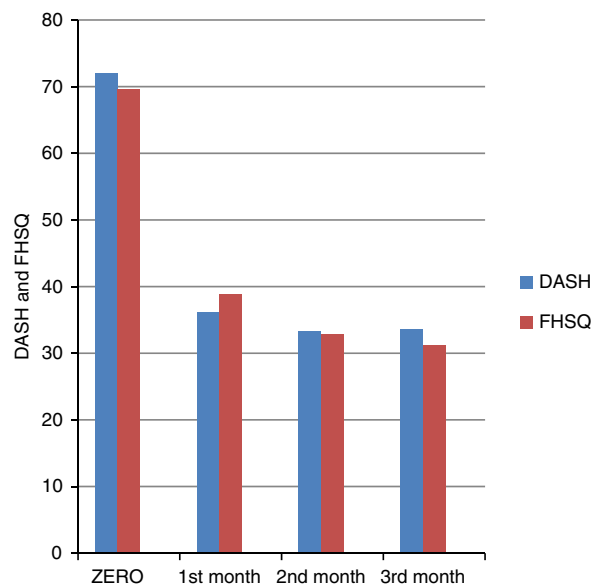


FIGURE 4. Graph showing improvement in Disability of the Arm, Shoulder, and Hand score in tennis elbow and Foot Health Status Questionnaire in tennis elbow and plantar fasciitis, respectively.

TABLE 2. Follow-up in patients with plantar fasciitis

Plantar fasciitis	1 st Visit (at the time of injury)	2 nd Visit (1 st month)	P value	3 rd Visit (2 nd month)	P value	4 th Visit (3 rd month)	P value
VAS	8.5±0.72	3.3±1.4	<0.003	2.6±1.65	<0.003	2.25±1.4	<0.0006
FHSQ	69.6±6.8	38.9±11.2	<0.0245	32.8±8.9	<0.002	31.25±8.32	<0.001

FHSQ, Foot Health Status Questionnaire; VAS, visual analog scale.

injection was given under ultrasound guidance, complete pain relief was seen up to 1 yr in 77.8% of patients, and reduced thickness was observed.

In our study, significant results were observed when VAS and FHSQ were compared before and after injection ($P < 0.003$); 82% patients had a decrease in VAS score ($> 50\%$) and around 60% had improvement in FHSQ score ($> 50\%$).

In conclusion, local injection of autologous PRP appeared to be a promising form of therapy for tennis elbow and plantar fasciitis. It is both safe (avoiding surgical complications) and effective in relieving pain and improving function. It is a cost effective procedure for the patients. The current available data support that repeated steroid injections are deleterious and may lead to serious consequences, and our study demonstrates a newer, safer, and better alternative for patients. However sustained efficacy of this promising and safer therapeutic option should be further evaluated in long-term follow-up studies that include a larger number of patients.

REFERENCES

- Geaney LE, Arciero RA, DeBerardino TM, et al. The effects of platelet-rich plasma on tendon and ligament: basic science and clinical application. *Op Techn Sports Med.* 2011; 19:160–164.
- Edwards SG, Calandruccio JH. Autologous blood injections for refractory lateral epicondylitis. *J Hand Surg.* 2003; 28:272–278.
- Eppley BL, Woodell JE, Higgins J. Platelet quantification and growth factor analysis from platelet-rich plasma: implications for wound healing. *Plast Reconstr Surg.* 2004; 114:1502–1508.
- Everts PA, Knape JT, Weibrich G, et al. Platelet-rich plasma and platelet gel: a review. *J Extracorp Tech.* 2006; 38:174.
- Weibrich G, Kleis WK, Hafner G, et al. Growth factor levels in platelet-rich plasma and correlations with donor age, sex, and platelet count. *Journal of Cranio-Maxillofacial Surgery.* 2002; 30:97–102.
- Landesberg R, Roy M, Glickman RS. Quantification of growth factor levels using a simplified method of platelet-rich plasma gel preparation. *Journal of Oral and Maxillofacial Surgery.* 2000; 58:297–300.
- Bhanot S, Alex JC. Current applications of platelet gels in facial plastic surgery. *Facial Plast Surg.* 2002; 18:27–34.
- Mishra A, Woodall J, Vieira A. Treatment of tendon and muscle using platelet-rich plasma. *Clin Sports Med.* 2009; 28:113–125.
- McAleer JP, Sharma S, Kaplan EM, et al. Use of autologous platelet concentrate in a nonhealing lower extremity wound. *Adv Skin Wound Care.* 2006; 19:354–363.
- Peerbooms JC, Sluimer J, Bruijn DJ, et al. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial: platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. *Am J Sports Med.* 2010; 38:255–262.
- Connell DA, Ali KE, Ahmad M, et al. Ultrasound-guided autologous blood injection for tennis elbow. *Skeletal Radiol.* 2006; 35:371–377.
- Gani N, Butt MF, Dhar SA, et al. Blood injection in the treatment of refractory tennis elbow. *Internet Journal of Orthopedic Surgery.* 2007; 6(4):5473.
- Filardo G, Kon E, Della Villa S, et al. Use of platelet-rich plasma for the treatment of refractory jumper's knee. *Int Orthop.* 2010; 34:909–915.
- James SL, Ali K, Pocock C, et al. Ultrasound guided dry needling and autologous blood injection for patellar tendinosis. *Br J Sports Med.* 2007; 41:518–521. discussion 522.
- Kon E, Filardo G, Delcogliano M, et al. Platelet-rich plasma: new clinical application: a pilot study for treatment of jumper's knee. *Injury.* 2009; 40:598–603.
- de Vos RJ, Weir A, van Schie HT, et al. Platelet-rich plasma injection for chronic Achilles tendinopathy: a randomized controlled trial. *JAMA.* 2010; 303:144–149.
- Randelli PS, Arrigoni P, Cabitza P, et al. Autologous platelet rich plasma for arthroscopic rotator cuff repair. A pilot study. *Disabil Rehabil.* 2008; 30:1584–1589.
- Everts PA, Devilee RJ, Brown Mahoney C, et al. Exogenous application of platelet-leukocyte gel during open subacromial decompression contributes to improved patient outcome. A prospective randomized double-blind study. *Eur Surg Res.* 2008; 40:203–210.
- Kon E, Buda R, Filardo G, et al. Platelet-rich plasma: intra-articular knee injections produced favorable results on degenerative cartilage lesions. *Knee Surg Sports Traumatol Arthrosc.* 2010; 18:472–479.
- Sanchez M, Azofra J, Anitua E, et al. Plasma rich in growth factors to treat an articular cartilage avulsion: A case report. *Med Sci Sports Exerc.* 2003; 35:1648–1652.
- Sánchez M, Anitua E, Azofra J, et al. Intra-articular injection of an autologous preparation rich in growth factors for the treatment of knee OA: a retrospective cohort study. *Clin Exp Rheumatol.* 2008; 26:910–913.
- Ibrahim V, Dowling H. Platelet-rich plasma as a nonsurgical treatment option for osteonecrosis. *PM&R.* 2012; 4:1015–1019.
- Bisset L, Beller E, Jull G, et al. Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. *BMJ.* 2006; 333:939.
- Cole C, Seto C, Gazewood J. Plantar fasciitis: evidence-based review of diagnosis and therapy. *Am Fam Physician.* 2005; 72:2237–2242.
- Buchbinder R. Plantar fasciitis. *N Engl J Med.* 2004; 350:2159–2166.
- Aspenberg P, Virchenko O. Platelet concentrate injection improves Achilles tendon repair in rats. *Acta Orthop Scand.* 2004; 75:93–99.
- Sanchez AR, Sheridan PJ, Kupp LI. Is platelet-rich plasma the perfect enhancement factor? A current review. *Int J Oral Maxillofac Implants.* 2003; 18:93–103.
- Mishra A, Pavelko T. Treatment of chronic elbow tendinosis with buffered platelet-rich plasma. *Am J Sports Med.* 2006; 34:1774–1778.
- Martinelli N, Marinozzi A, Carni S, et al. Platelet-rich plasma injections for chronic plantar fasciitis. *Int Orthop.* 2013; 37:839–842.
- Barrett BSL, Erredge SE. Feature: growth factors for chronic plantar fasciitis? *Podiatry Today.* 2004; 17:1045–7860.