

ORIGINAL RESEARCH

Comparative Study Of Corticosteroids Versus Platelet Rich Plasma For The Treatment Of Plantar Fasciitis In A Tertiary Care Centre

Misab Bin Muhammad¹, Rameejan Begum², Pratheesh Mohanraj³, Adhiyamaan RV⁴, F. Abdul Khader⁵, Dineshram Devakumar⁶, Dr. Harish. S⁷, Naim Akbar⁸, Rupesh Kanna⁹

¹Post Graduate, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

²Assistant Professor, Chettinad Medical College & Hospital, Kelambakkam, Chengalpet District, Tamilnadu – 603103, India.

³Assistant Professor, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

⁴Assistant Professor, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

⁵Professor, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

⁶Post Graduate, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

⁷Post Graduate, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

⁸Post Graduate, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

⁹Post Graduate, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

Received Date: 11/11/2022

Acceptance Date: 08/01/2023

ABSTRACT

Background: People will get plantar fasciitis or fasciopathy nearly 10% in their lifetime, which affects the plantar fascia and causes abnormal thickening and structure. Most patients will be healed within 6 to 12 months, however other people can experience symptoms for much longer. The main aim of this study was to compare the effects of corticosteroid and platelet rich plasma (PRP) for the treatment of plantar fasciitis. **Methods:** The present study was conducted in department of orthopaedics at tertiary care centre Chengalpattu district. In this study, Sampling for the selection of study subjects with Randomisation for the allocation of interventions. Total of 60 both in patients and out patients with plantar fasciitis with the age group between 30 to 50 years, were treated with corticosteroids and platelet rich plasma (PRP), for 18 months. Thirty patients were treated with platelet rich plasma. The platelet rich plasma (PRP) was prepared from venous whole blood. The other thirty patients were treated with corticosteroid injection. The primary analysis included visual analogue scale (VAS) pain scores and the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hind foot outcome scores. **Results:** The PRP group was more often successfully treated than the corticosteroid group. When baseline VAS and AOFAS scores were compared with the scores at 12 weeks follow up, both groups showed improvement across time

(intention-to-treat principle). The mean VAS and AOFAS heel pain scores measured 6 weeks after treatment were 77.5 in steroid group and 87.5 in PRP group, and the scores in both groups were significantly lower when compared with pre-treatment levels. PRP treatment was more effective resulted higher improvement in VAS score and in AOFAS score at 6 weeks as compared to steroid injection (P value<0.001). Conclusion: Treatment of patients with plantar fasciitis with PRP reduces pain and increases function significantly, exceeding the effect of corticosteroid injection at the end of 6 weeks. Hence, we concluded that PRP injection is more effective in resulting pain relief and function as compared to corticosteroid injection.

Key words: plantar fasciitis, platelet rich plasma, VAS, AOFAS.

Corresponding Author: Dr. F. Abdul Khader, Professor, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpet District, Tamilnadu – 603108, India.

INTRODUCTION

The incidence and prevalence of plantar fasciitis by age are unknown. This condition accounts for 15% of foot disorders. Some studies reported prevalence rate among a population of runner to be as high as 22%. More than 10% of the population is affected by it over lifetime⁽¹⁾. It may bilaterally in a third of cases. Approximately 90% of cases are treated successfully with conservative care^(2,3,4). Females are commonly affected than males⁽⁵⁾. Some studies explained that it is caused by repeated microtrauma.

Plantar fasciitis etiology remains unknown but is believed to be multifactorial. This may be caused by obesity, poor foot and ankle biomechanics, flat feet, prolonged standing, jumping, running and ill-fitting footwear. Plantar fasciitis can also be associated occasionally with other systemic diseases like seronegative spondyloarthropathies⁽⁶⁾.

But some studies explained that it is caused by repeated microtrauma. PF previously considered an acute inflammatory disease, is now histologically considered to be a chronic degenerative process without inflammation⁽⁷⁾. The condition is diagnosed with the presence of clinical findings such as heel pain and tightness over the heel⁽⁸⁾.

More knowledge on the pathology of plantar fasciitis helps to apply various conservative treatments like physiotherapy, stretching exercises, ice packs, night splints, shoe modification and the use of non steroidal anti inflammatory drugs (NSAIDS)⁽⁹⁾. The treatment for plantar fasciitis may need a combination of treatment application, rather than administering only one treatment at a time. There is no proven specific treatment that had been set as a gold standard treatment for chronic plantar fasciitis.

Local injection techniques are used commonly secondary to conservative therapies in the patients who resistant plantar fasciitis. Corticosteroid injections have been used to treat heel pain since 1950s⁽¹⁰⁾. Low cost, low complexity and rapid pain relief are the advantages of corticosteroids injection but it is associated with potential complications which may overcome its benefits. Cochrane review on the effect of corticosteroid for plantar fasciitis showed improvement in symptoms at one month, but not for a long lasting effect⁽¹¹⁾. Although popular, steroid injections appear to be effective only briefly and to a limited extent in curing the illness. The use of corticosteroids has been associated to plantar fascia rupture, particularly following numerous local injections.

Platelet rich plasma (PRP), consists of concentration of natural autologous growth factors. The platelet-rich plasma (PRP) injections is now recently introduced and considered as an effective treatment for plantar fasciitis. Regeneration of tendons by matrix synthesis, cellular chemotaxis, and proliferation are some of the benefits⁽¹²⁾.

Abnormal thickening of the plantar fascia (> 4.0 mm) in plantar fasciitis is noted in almost all cases⁽¹³⁾. The thickening of plantar fascia can be assessed by using ultrasonography (USG)

⁽¹⁴⁾. Several studies confirmed that both corticosteroid and PRP injections are effective in reducing pain and also the plantar fascia thickness ^(15, 16, 17).

Platelet rich plasma (PRP) is marketed as the best autologous biological blood-derived product because it may be given exogenously to a variety of tissues, releasing high quantities of platelet-derived growth factors that improve tendon, bone, and wound healing. Additionally, PRP has antibacterial qualities that might help to avoid infections.

Growth factors are released when platelets are activated, starting the body's normal healing process. These platelets may trigger a healing response if injected where the fascia attaches. In order to compare and evaluate the function and effectiveness of corticosteroid versus autologous PRP injection in treating plantar fasciitis, this study was conducted.

In this study, we compared the efficacy of PRP and steroid injection in the treatment of chronic plantar fasciitis in terms of symptomatic relief and also analysed the improvement of foot function over a period of six months.

The objectives of the study are to compare the clinical outcome of PRP injection versus steroid injection in the treatment of plantar fasciitis in terms of symptomatic relief and to evaluate the improvement of foot function and patient satisfaction over a period of six months.

METHODOLOGY

The study of 60 patients (Divided into two groups with 30 each) who were diagnosed as plantar fasciitis for the duration of 18 months in a tertiary care hospital. Sampling for the selection of study subjects with Computerized Randomisation for the allocation of interventions.

Study approval and trial registration

Institutional Ethical Committee approval 2021/651, dated 29/01/2021.

Clinical trial registry of India [CTRI 2022/10/059486]. This clinical research was done following the ethical principles for medical research involving human subjects in accordance with the Helsinki Declaration 2013.

Inclusion Criteria: Patients were selected between the age group 30 to 50years and All patients with established plantar fasciitis

Exclusion Criteria: Patient with Congenital deformity of lower limb, Achilles tendon pathology, Previous surgery for heel pain, Injury to heel were exempted from the study.

Methods of Data Collection:

Patients who were clinically diagnosed with Plantar fasciitis and who have fitted into above inclusion and exclusion criteria was explained about the procedure. The participant was enrolled after getting a written and informed consent in their vernacular language. Patient who is willing to do the treatment was selected randomly.

The present study attempts to compare the effectiveness of platelet rich plasma injection versus corticosteroid injection as a treatment for plantar fasciitis.

The Drug used for the injection were Triamcinolone 40mg and Methylprednisolone.

Platelet Rich Plasma Preparation:

Using a 16 or 18 G syringe, 10ml of blood was withdrawn from peripheral vein. Venous blood was taken into Acid citrate dextrose tube which avoids platelet activation and degranulation due to its anticoagulant properties.

Centrifugation was carried out immediately at 3200 rpm for a total of 12min. This separates blood into three layers, the top layer consisted of platelet-poor plasma, the middle layer contained about 1.5ml of platelet rich plasma as well as a buffy coat of white blood cells and the bottom layer consisted of red blood cells. The layer of PRP was easily extractable at the time of use.

Eligibility for injection therapy:

Age eligibility for study: 30 to 50 years
 Genders: Both male and female
 Healthy volunteers: Not accepted

Outcome Measures:

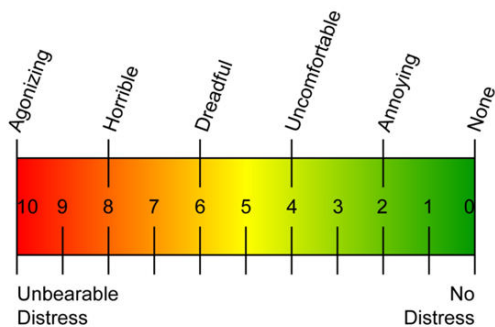
Patients were evaluated as per clinical parameters-Visual analogue scale (VAS) assessment of pain relief and The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle Hind foot Score commonly used instruments for measuring the outcome of treatment.

Visual Analogue Scale (VAS):

A Visual Analogue Scale (VAS) is one of the pain rating scales used for the first time in 1921 by Hayes and Patterson⁽¹⁸⁾. It is a measuring scale used to measure various amount of pain noted by the patients. Scale score ranging from 0 (no pain) to 100(severe or bad pain). It is a continuous scale comprised of a horizontal (HVAS) and vertical (VVAS) line, 100mm in length written word description at the ends.

The patient was asked to mark their pain level in the scale, VAS score was recorded by measuring in millimeters from the right side end of the line to the point that the patient marks. Outcome is measured by the changes in pain measured by Visual Analogue Scale and AOFAS Score with the time period of baseline, 1 month, 1week, 2 month, 2 week, 3 week and 6 weeks. The adverse events were recorded throughout the entire 2 months.

VISUAL ANALOGUE SCALE



Task _____

Date _____ Start _____ End _____

Figure 1: Visual Analogue Scale

THE AMERICAN ORTHOPAEDIC FOOT AND ANKLE SOCIETY (AOFAS) ANKLE-HINDFOOT SCORE

Table 1: Parameters

PAIN (40 points)	
None	40
Mild	30
Moderate	20
Severe	0
FUNCTION (50 POINTS) ACTIVITY LIMITATIONS	
None	10
Limitations on recreational activities	7
Some limitations on daily and recreational activities	4
Severe limitations on daily and recreational	0

activities	
MAXIMUM CONTINUOUS WALKING DISTANCE	
600 metres or more	5
400 metres to less than 600 metres	4
100 metres to less than 400 metres	2
Less than 100 metres	0
WALKING SURFACES	
No difficulty on any surface	5
Some difficulty on uneven terrain, stairs and inclines	3
Severe difficulty or inability to walk on uneven terrain, stairs and inclines	0
GAIT ABNORMALITY	
None or slight	8
Obvious (walking possible but gait abnormality obvious)	4
Marked (walking difficult but gait abnormality obvious)	0
SAGITTAL MOTION(FLEXION PLUS EXTENSION)	
Normal or mild restriction(30 degree or more)	8
Moderate restriction(15 -29 degree)	4
Severe restriction (less than 15 degree)	0
HIND FOOT MOTION(INVERSION PLUS EVERSION)	
Normal or mild restriction(75- 100 % normal)	6
Moderate restriction(25- 74 % normal)	3
Severe restriction(less than 25% normal)	0
ANKLE HIND FOOT STABILITY(ANTERIOR, DRAWER,VARUS – VALGUS STRESS)	
Stable	8
Unstable	0
ALIGNMENT (10 POINTS)	
Good, plantigrade foot, well aligned	10
Fair, plantigrade foot, mild to moderate degree of malalignment	5
Poor, nonplantigrade foot, severe malalignment	0

The AOFAS Ankle-Hindfoot Score is commonly used in patients with an ankle or hindfoot injury. This instrument combines functional outcome and pain, which are both critical for patients. The AOFAS Ankle Hindfoot Score is only valid if the score truly reflects function and pain.

Sample Size Calculation:

Sample size calculation based on the previous study, the mean and SD of study group of corticosteroid versus platelet rich plasma in treatment of Plantar Fasciitis, the values are 85.72 ± 2.36 and 78.57 ± 1.91 with 5% level of significance and 80% power the total sample size 30 in each group including 10% non-response error.

Study Procedure:

A sample size of 60 patients. Data collected from patients (Both IPD and OPD) presenting

with Plantar Fasciitis satisfying inclusion and exclusion criteria, in Tertiary care Centre Chengalpattu District, Tamil Nadu from the year 2020-2022.

On presentation at the OPD a detailed history was taken from the patient starting with the age, name and sex.

A thorough clinical assessment was carried out which included the patient general condition and local examination findings are noted.

Evaluation of outcome:

Patients were clinically evaluated during post operative follow up of period of 1 week, 2week, 1 month and 6 months.

Patients evaluated as per clinical parameters-Visual analogue scale (VAS) assessment of pain relief and The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score commonly used instruments for measuring the outcome of treatment.

Statistical Method:

Data was entered in MS-Excel and statistical analysis done by SPSS 23 software. The result presented in descriptive statistics and appropriate test of significance applied with 5% level of significance an 95% of confidence interval.

Independent t-test was used to compare the mean difference between the two groups, paired t-test was used to compare the mean difference between before and after paired data. In all the above tests the P value of <0.05 is accepted as indicating as statistical significance.

SEX DISTRIBUTION

TYPE * SEX Crosstabulation

Table 2: Sex Distribution

			SEX		Total
			F	M	
TYPE	PRP	Number	19	11	30
		%	63.3%	36.7%	100.0%
	STEROI D	Number	24	6	30
		%	80.0%	20.0%	100.0%
Total		Number	43	17	60
		%	71.7%	28.3%	100.0%

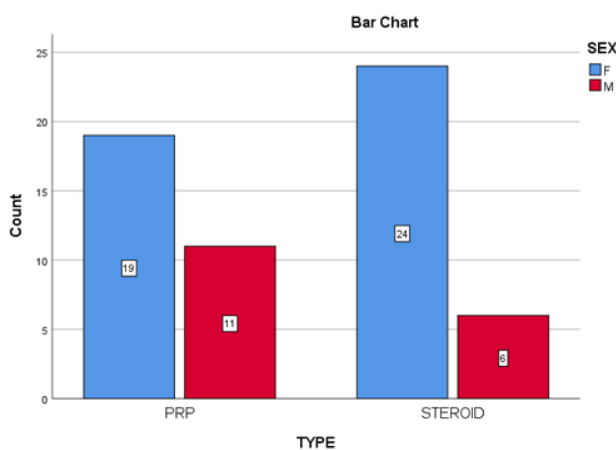


Figure 2: Sex Distribution

AGE DISTRIBUTION

Table 3: Age Distribution

			Age
TYPE	PRP	Mean	41.53

		SD	7.628
	STEROID	Mean	42.03
		SD	8.096

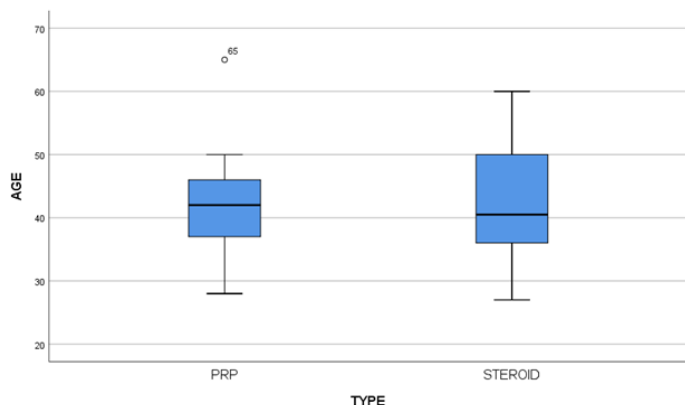


Figure 3: Age Distribution

SIDE DETERMINATION

Table 4: Side Determination

TYPE * SIDE Crosstabulation						
			SIDE			Total
			BOTH	LEFT	RIGHT	
TYPE	PRP	Count	11	6	13	30
		% within TYPE	36.7%	20.0%	43.3%	100.0%
	STEROID	Count	5	7	18	30
		% within TYPE	16.7%	23.3%	60.0%	100.0%
Total		Count	16	13	31	60
		% within TYPE	26.7%	21.7%	51.7%	100.0%

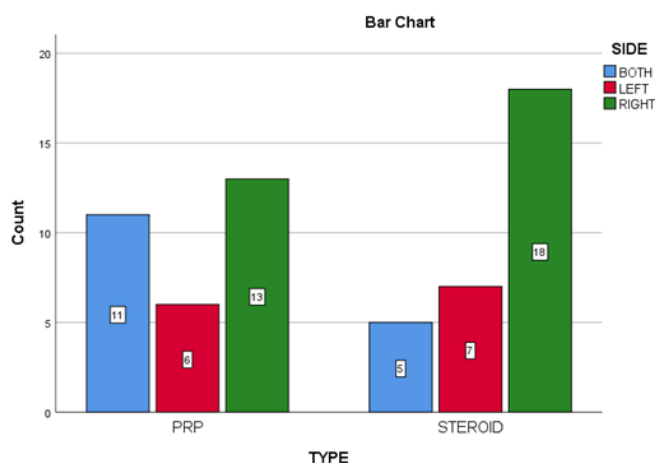


Figure 4: Side Determination

TIME OF HEALING

Table 5: Time of Healing

Time of Healing	N	Median	Interquartile Range	Pvalue
PRP	30	82	2	<0.001
Steroids	30	78	2.75	

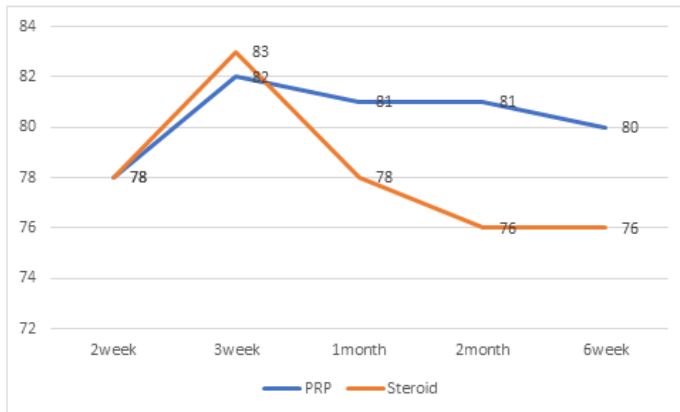


Figure 5: Time of Healing

Time of healing is 82% in PRP compared to steroid 78%

RESULTS

All the relevant data's were analyzed. The average Visual Analogue Scale (VAS) and AOFAS scores in both the groups of pre injection, 1 week, 1 month, and 6 month post injection are shown in the below tables:

VAS SCORE

Table 6: VAS Score

VAS score	N	Median	Interquartile Range	Pvalue
PRP	30	1	1	<0.001
Steroids	30	3	0	

Pain score is reduced in the PRP group then in steroids and this result is statistically significant (Pvalue<0.001)

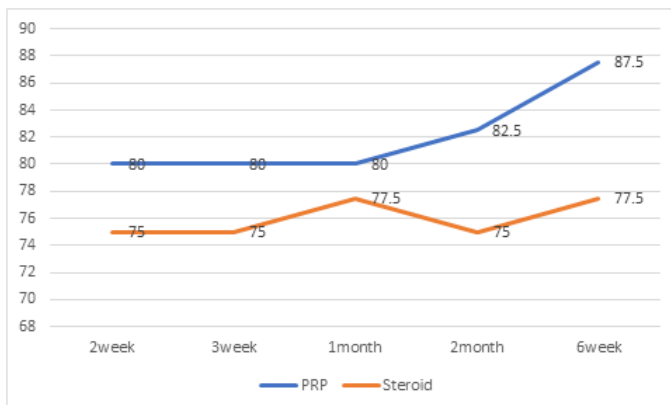


Figure 6: VAS Score

AOFAS SCORE

Table 7: AOFAS Score

AOFAS Scale	N	Median	Interquartile Range	Pvalue
PRP	30	80	5	<0.001
Steroids	30	75	5	

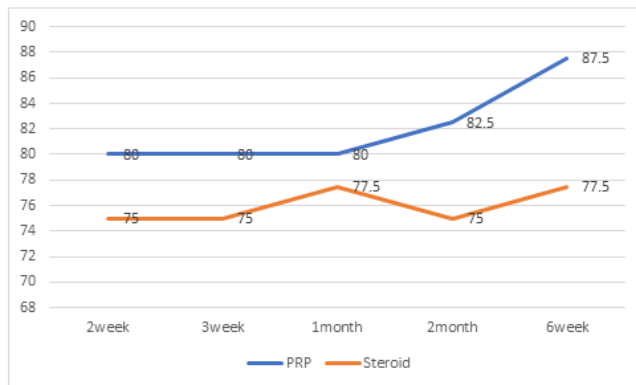


Figure 7: AOFAS Score

The data does not support normal distribution since there are few extreme values, hence performing a non-parametric Mann-Whitney test to compare the AOFAS variable between PRP and steroids. The median(IQR) for PRP is 80(5) and for steroids is 75(5), Overall there is a 5-unit difference between PRP and steroids on AOFAS Scale, This proves AOFAS scale is better in PRP compared to steroids and this is statistically significant(P value<0.001).

DISCUSSION

The plantar heel pain is very common complaints that cause significant discomfort and disability. Plantar heel pain or plantar fasciitis or fasciopathy which accounts for 11-15% of all foot complaints needed professional care in adults⁽¹⁹⁾. The incidence of plantar fasciitis was 3.83 cases per 1000 patient years and with prevalence percentage of 0.4374.

Some studies showed that there is an association between sex and plantar fasciitis and in some studies showed that plantar fasciitis is increased prevalence in men^(20, 21) while others showed an increased prevalence in women^(22, 23). In our study we found that females are more affected with plantar fasciitis than males.

There are three components of the plantar fascia, all components originate from the calcaneus, and each component plays an important role in normal foot biomechanics. The important functions of the fascia are to support the arch and absorbing shock. Several studies showed that despite the term "itis," there are no inflammatory cells present in this condition^(24,25,26). Several risk factors can contribute to plantar fasciitis, but the most common cause is overuse stress. The classical clinical presentation is a sharp heel pain, and in some cases calcaneal spur is seen. Most of the treatments for plantar fasciitis are ineffective and not satisfactory for patients⁽²⁷⁾.

The overuse stress results in torn of plantar fascia. Some foot abnormalities like pes planus, pes cavus, and limited ankle dorsiflexion, excessive pronation and supination may also causes plantar fasciitis. In pes planus, the plantar fascia is subjected to increased strain. In pes cavus, there is loss of foot eversion or shock absorption effectively, and this can cause excessive strain on the heel. The patients with pes cavus may also have spasm over the gastrocnemius, soleus, and posterior leg muscles. The gait cycle of the patients are affected by these tight muscles. In about 50% of the cases, there is presence of calcaneal spur that is not directly responsible for this condition. The plantar fasciitis is more common in runners and older adults, and obesity, heel pad atrophy, and occupations with prolonged standing also other risk factors. Seronegative spondyloarthropathies and plantar fasciitis have been found to have a close relationship, but systemic factors are unknown in approximately 85% of cases⁽²⁸⁾. In our study we compare the effects platelets rich plasma and corticosteroids for the treatment of plantar fasciitis.

Population-based studies estimated the prevalence of plantar fasciitis among the varying age

groups. In Australia, the North West Adelaide Health Study in 3,206 people, the age 18 years are over reported which accounts for 3.6% of the sample had plantar heel pain⁽²⁹⁾. In the USA, the Feet First study in 784 people, the age of 65 years and found that 6.9% reported tenderness in the plantar fascia and 4.2% reported tenderness in the plantar heel pad⁽³⁰⁾, while the Framingham reported in the study of 3,378 people, the aged 18 years and over reported the prevalence of heel pain to be 7.3%⁽³¹⁾

Some studies showed that the plantar fasciitis is commonly seen between the ages of 25 and 65 years old. Some literature shows prevalence rates among a population of runners to be as high as 22%^(32,33). Our study showed the prevalence of plantar fasciitis is seen the person with the age above 40 years.

The plantar fasciitis is a common condition usually unilateral. Bilateral presentation is seen with a systemic cause. PF is commonly unilateral, but 30% of cases shows bilateral presentation⁽³⁴⁾. It may present bilaterally in a third of the cases. When plantar fasciitis occurs, it is usually unilateral (70% of cases)⁽³⁵⁾. In our study we found out that the plantar fasciitis occurs unilaterally, and it is more on the right side.

Celik D et al reported that corticosteroid injection is more effective than physical therapy, foot orthoses and PRP only in short term upto 6 weeks⁽³⁶⁾. Diaz-Llopis IV explained that corticosteroid injection when compared with botulinum toxin A injection, corticosteroid is more effective than botulinum toxin A, but it is of short term effect⁽³⁷⁾. Corticosteroid is similar to placebo injection for pain and function⁽³⁸⁾. In our study we also found that corticosteroid injection is more effective only in short term.

Some studies showed, in reduction of plantar fasciitis thickness corticosteroid injection was not effective than other comparators. Corticosteroid injection was safe intervention but the post injection pain is commonly reported in patients.

Sellman JR, studied in two cases of patient with plantar fasciitis in 1990, reported that there is an increased risk of plantar fascia rupture followed by corticosteroid injection⁽³⁹⁾. Complications of corticosteroid injection in plantar fasciitis are plantar fascia rupture and infection was noted in some literature. But in our study we have not found any such complications.

McMillan AM studied that the corticosteroid injection inhibits the proliferation of fibroblasts and the expression of proteinous substance⁽⁴⁰⁾. The VAS score after corticosteroid injection was reduced compared to VAS score taken before injection. In our study we also found reduction of VAS score after corticosteroid injection than compared before injection.

Several studies showed that VAS score is commonly used to evaluate the effect of various treatments for plantar fasciitis⁽⁴¹⁾. In treating plantar fasciitis, pain relief is not enough, functional improvement is also very important. Several recent literature, the functional improvement of any therapy was measured by using AOFAS score^(42,43,44). Our study, uses VAS and AOFAS was used to report outcomes measures of steroid and PRP injection for plantar fasciitis.

Cytokines and growth factors plays an important role in treatment of plantar fasciitis. Martinelli et al showed PRP is rich in TGF- β , VEGF, PDGF and several other inflammatory cytokines and interleukins⁽⁴⁵⁾. The combination of growth factors and anti-inflammatory cytokines promotes healing and reverse degenerative process.

Recent literatures showed PRP increased collagen gene expression and production of growth factors to promote healing. Local PRP injection promotes delievery of growth factors and high concentration of PRP reverse the degeneration process^(46,47).

Ling et al, found PRP is more effective than steroid and placebo in the change of AOFAS score. This is similar to our results⁽⁴⁸⁾. Hsiao et al⁽⁴⁹⁾ showed PRP as the autologues blood derived products showed a greater reduction in VAS score compare to corticosteroid injection at three months. Several studies showed PRP is superior than corticosteroid in long term

clinical effect.

Shetty et al, compared the effects of corticosteroid (30 patients) with PRP injection (30 patients). After three months, the outcome measures showed improvement in both groups. The results were much better in PRP than corticosteroid group⁽⁵⁰⁾.

Say et al compared the effects of PRP and steroid in patients with plantar fasciitis⁽⁵¹⁾. PRP treatment shows VAS and AOFAS score more changes than in steroid group at 6 weeks and 6 months⁽⁵²⁾. Our study suggested that PRP treatment group was associated with greater changes in VAS and AOFAS than steroid group.

Monto et al⁽⁵³⁾ in this study, PRP and corticosteroid group produces more difference in AOFAS score was clinically significant at 12 and 24 months evaluation. Our study showed that PRP is more effective than steroid in the long term in plantar fasciitis.

With all this available evidence, with the assessment using VAS and AOFAS score changes, we concluded that PRP injection is more effective than corticosteroid injection was clinically significant at 1 week, 2 weeks, 1 month, 6 week and 2 months in long term for the management of plantar fasciitis

CONCLUSION

In conclusion, the comparative study of treatment of plantar fasciitis with platelet rich plasma verses corticosteroid injection shows that a single injection of autologous platelet rich plasma improves heel pain and functional activities more effectively than corticosteroid injection in plantar fasciitis. These improvements were maintained over in our follow up period without any significant complications. Corticosteroid gives better results up to eighth week and after that pain decreased slightly. Long term follow up with more number of patients is needed to evaluate lasting benefits of pain relief and functional improvement in plantar fasciitis.

REFERENCES

1. Buchbinder R. Clinical practice. Plantar fasciitis. *N Engl J Med* 2004;350:2159-66.
2. McPoil TG, Martin RL, Cornwall MW, Wukich DK, Irrgang JJ, Godges JJ. Heel pain-plantar fasciitis: clinical practice guidelines linked to the international classification of function, disability, and health from the orthopaedic section of the American Physical Therapy Association. *J Orthop Sports Phys Ther.* 2008;38(4):A1–A18. doi:10.2519/jospt.2008.0302.
3. Riddle DL, Pulisic M, Pidcoe P, Johnson RE. Risk factors for Plantar fasciitis: a matched case-control study. *J Bone Joint Surg Am.* 2003;85-A(5):872–7
4. Thomas JL, Christensen JC, Kravitz SR, et al. The diagnosis and treatment of heel pain: a clinical practice guideline-revision 2010. *J Foot Ankle Surg.* 2010;49(3 Suppl):S1–19.
5. Lopes AD, Hespanhol Júnior LC, Yeung SS, Costa LOP. What are the main running-related musculoskeletal injuries? A Systematic Review. *Sports Med.* 2012;42(10):891–905.
6. Taunton JE, Ryan MB, Clement DB, McKenzie DC, Lloyd-Smith DR, Zumbo BD. A retrospective case-control analysis of 2002 running injuries. *British Journal of Sports Medicine.* 2002;36(2):95–101.
7. David JA, Sankarapandian V, Christopher PR, Chatterjee A, Macaden AS: Injected corticosteroids for treating plantar heel pain in adults. *Cochrane Database Syst Rev.* 2017, 8:CD009348. [10.1002/14651858.CD009348.pub2](https://doi.org/10.1002/14651858.CD009348.pub2)
8. Assad S, Ahmad A, Kiani I, Ghani U, Wadhwa V, Tom TN: Novel and conservative approaches towards effective management of plantar fasciitis. *Cureus.* 2016, 8:e913. [10.7759/cureus.913](https://doi.org/10.7759/cureus.913)
9. Tahirian MA, Motififard M, et al. Plantar fasciitis. *J Res Med Sci* 2012 Aug;17(8):799–804.

10. Lapidus PW, Guidotti FP. Local injections of hydrocortisone in 495 orthopedic patients. *Ind Med Surg* 1957 May;26(5):234–244.
11. Crawford F, Thomson C. Interventions for treating plantar heel pain. *Cochrane Database Syst Rev*. 2003;(3):CD000416.
12. Lee TG, Ahmad TS. Intralesional autologous blood injection compared to corticosteroid injection for treatment of chronic plantar fasciitis. A prospective, randomized, controlled trial. *Foot Ankle International*. 2007;28(9):984–990.
13. McMillan AM, Landorf KB, Barrett JT, Menz HB, Bird AR. Diagnostic imaging for chronic plantar heel pain: a systematic review and meta-analysis. *Journal of Foot Ankle Research*. 2009;13(2):32.
14. Kane D, Greaney T, Shanahan M, Duffy G, Bresnihan B, Gibney R, FitzGerald O. The role of ultrasonography in the diagnosis and management of idiopathic plantar fasciitis. *Rheumatology (Oxford)* 2001;40(9):1002–1008.
15. Genc H, Saracoglu M, Nacir B, Erdem HR, Kacar M. Long-term ultrasonographic follow-up of plantar fasciitis patients treated with steroid injection. *Joint Bone Spine*. 2005;72(1):61–65.
16. Radwan A, Wyland M, Applequist L, Bolowsky E, Klingensmith H, Virag I. Ultrasonography, an effective tool in diagnosing plantar fasciitis: a systematic review of diagnostic trials. *International Journal of Sports Physical Therapy*. 2016;11(5):663–671.
17. Tsai WC, Hsu CC, Chen CP, Chen MJ, Yu TY, Chen YJ. Plantar fasciitis treated with local steroid injection: comparison between sonographic and palpation guidance. *Journal of Clinical Ultrasound*. 2006;34(1):12–16.
18. Delgado DA, Lambert BS, Boutris N, McCulloch PC, Robbins AB, Moreno MR, Harris JD.
19. Riddle DL, Schappert SM. Volume of ambulatory care visits and patterns of care for patients diagnosed with plantar fasciitis: a national study of medical doctors. *Foot Ankle Int*. 2004;25(5):303–310.
20. Rano JA, Fallat LM, Savoy-Moore RT. Correlation of heel pain with body mass index and other characteristics of heel pain. *J Foot Ankle Surg* 2001;40(6):351-356.
21. Taunton JE, Ryan MB, Clement DB, et al. A retrospective case-control analysis of 2002 running injuries. *Br J Sports Med* 2002;36(2):95-101.
22. Lapidus PW, Guidotti FP. Painful heel: Report of 323 Patients with 364 painful heels. *Clin Orthop Relat Res* 1965;39:178-186.
23. Davis PF, Severud E, Baxter DE. Painful heel syndrome: results of nonoperative treatment. *Foot Ankle Int* 1994;15(10):531-535.
24. Becker BA, Childress MA: Common foot problems: over-the-counter treatments and home care. *Am Fam Physician*. 2018, 98:298-303.
25. Ling Y, Wang S: Effects of platelet-rich plasma in the treatment of plantar fasciitis: a meta-analysis of randomized controlled trials. *Medicine (Baltimore)*. 2018, 97:e12110. [10.1097/MD.00000000000012110](https://doi.org/10.1097/MD.00000000000012110)
26. Lee YK, Lee M: Treatment of infected Achilles tendinitis and overlying soft tissue defect using an anterolateral thigh free flap in an elderly patient: A case report. *Medicine (Baltimore)*. 2018, 97:e11995. [10.1097/MD.00000000000011995](https://doi.org/10.1097/MD.00000000000011995)
27. Buchanan BK, Kushner D: Plantar Fasciitis [Updated 2022 May 30]. StatPearls Publishing, Treasure Island (FL); 2022.
28. Hill CL, Gill TK, Menz HB, Taylor AW. Prevalence and correlates of foot pain in a population-based study: the North West Adelaide health study. *J Foot Ankle Res*. 2008;1(1):2.
29. Dunn JE, Link CL, Felson DT, Crincoli MG, Keysor JJ, McKinlay JB. Prevalence of foot and ankle conditions in a multiethnic community sample of older adults. *Am J Epidemiol*.

- 2004;159:491–8.
30. Dufour AB, Broe KE, Nguyen US, Gagnon DR, Hillstrom HJ, Walker AH, Kivell E, Hannan MT. Foot pain: is current or past footwear a factor? *Arthritis Rheum.* 2009;61:1352–8.
 31. Cotchett M, Lennecke A, Medica VG, Whittaker GA, Bonanno DR. The association between pain catastrophising and kinesiophobia with pain and function in people with plantar heel pain. *Foot (Edinb).* 2017 Aug;32:8-14.
 32. Tschopp M, Brunner F. [Diseases and overuse injuries of the lower extremities in long distance runners]. *Z Rheumatol.* 2017 Jun;76(5):443-450.
 33. Roxas M. Plantar fasciitis: Diagnosis and therapeutic considerations. *Altern Med Rev.* 2005;10:83–93.
 34. Tahririan MA, Motififard M, Tahmasebi MN, Siavashi B (August 2012). "Plantar fasciitis". *Journal of Research in Medical Sciences.* **17** (8): 799–804.
 35. Celik D, Kus G, Sırma SÖ. Joint mobilization and stretching exercise vs steroid injection in the treatment of plantar fasciitis: a randomized controlled study. *Foot Ankle Int.* 2016;37:150–6.
 36. Elizondo-Rodriguez J, Araujo-Lopez Y, Moreno-Gonzalez JA, CardenasEstrada E, Mendoza-Lemus O, Acosta-Olivo C. A comparison of botulinum toxin a and intralesional steroids for the treatment of plantar fasciitis. *Foot Ankle Int.* 2013;34:8–14.
 37. Zhang W, Doherty M. Efficacy paradox and proportional contextual effect (PCE). *Clin Immunol.* 2018;186:82–6.
 38. Sellman JR. Plantar fascia rupture associated with corticosteroid injection. *Foot Ankle Int.* 1994;15:376–81.
 39. McMillan AM, Landorf KB, Gilheany MF, Bird AR, Morrow AD, Menz HB. Ultrasound-guided injection of dexamethasone versus placebo for treatment of plantar fasciitis: protocol for a randomized controlled trial. *Journal of foot and ankle research.* 2010 Dec; 3(1):1-8
 40. Mahindra P, Yamin M, Selhi HS, Singla S, Soni A. Chronic plantar fasciitis: effect of platelet-rich plasma, corticosteroid, and placebo. *Orthopedics.* 2016 Mar 1;39(2):e285ee289.
 41. Tiwari M, Bhargava R. Platelet rich plasma therapy: a comparative effective therapy with promising results in plantar fasciitis. *J Clin Orthop Trauma.* 2013 Mar;4(1):31e35.
 42. Lemont H, Ammirati KM, Usen N. Plantar fasciitis. *J Am Podiatr Med Assoc.* 2003 May 1;93(3):234e237.
 43. Molloy T, Wang Y, Murrell GAC. The roles of growth factors in tendon and ligament healing. *Sports Med.* 2003;33(5):381e394.
 44. Anitua E, Pino A, Orive G. Plasma rich in growth factors promotes dermal fibroblast proliferation, migration and biosynthetic activity. *J Wound Care.* 2016 Nov 2;25(11):680e687.
 45. Martinelli N, Marinozzi A, Carnì S, Trovato U, Bianchi A, Denaro V. Platelet-rich plasma injections for chronic plantar fasciitis. *Int Orthop.* 2013 May;37(5): 839e842.
 46. Fenwick SA, Hazleman BL, Riley GP. The vasculature and its role in the damaged and healing tendon. *Arthritis Res.* 2002;4(4):252.
 47. Wang JH-C, Nirmala X. Application of tendon stem/progenitor cells and platelet-rich plasma to treat tendon injuries. *Operat Tech Orthop.* 2016 Jun;26(2):68e72.
 48. Ling Y, Wang S. Effects of platelet-rich plasma in the treatment of plantar fasciitis: a meta-analysis of randomized controlled trials. *Medicine (Baltim).* 2018 Sep;97(37), e12110.
 49. Hsiao M-Y, Hung C-Y, Chang K-V, Chien K-L, Tu Y-K, Wang T-G. Comparative effectiveness of autologous blood-derived products, shock-wave therapy and

- corticosteroids for treatment of plantar fasciitis: a network meta-analysis. *Rheumatol Oxf Engl.* 2015 Sep;54(9):1735e1743.
50. Shetty VD, Dhillon M, Hegde C, Jagtap P, Shetty S. A study to compare the efficacy of corticosteroid therapy with platelet-rich plasma therapy in recalcitrant plantar fasciitis: a preliminary report. *Foot Ankle Surg Off J Eur Soc Foot Ankle Surg.* 2014 Mar;20(1):10e13.
 51. Say F. Comparison of platelet-rich plasma and steroid injection in the treatment of plantar fasciitis. *Acta Orthop Traumatol Turcica.* 2014;48(6):667e672.
 52. Lemont H, Ammirati KM, Usen N. Plantar fasciitis. *J Am Podiatr Med Assoc.* 2003 May 1;93(3):234e237.
 53. Monto RR. Platelet-rich plasma efficacy versus corticosteroid injection treatment for chronic severe plantar fasciitis. *Foot Ankle Int.* 2014 Apr;35(4): 313e31.