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Effectiveness of Ultrasonography-Guided Steroid Injection for Treating Plantar Fasciitis – A Prospective Study

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ABSTRACT

Background: Plantar fasciitis is a common cause of heel pain, often affecting middle-aged individuals and leading to significant functional limitation. Ultrasound-guided steroid injections have emerged as an effective treatment modality, offering improved accuracy and outcomes.
Aim: To evaluate the effectiveness of ultrasound-guided steroid injection in patients with plantar fasciitis by assessing changes in pain, plantar fascia thickness, and heel pad thickness.
Materials and Methods: This prospective observational study was conducted on 147 patients with plantar fasciitis at a tertiary care centre from March 2024 to December 2025. Patients received an ultrasound-guided injection of triamcinolone with lignocaine. Clinical assessment included the Visual Analogue Scale (VAS) for pain, and ultrasonographic measurement of plantar fascia and heel pad thickness at baseline, 2 weeks, and 3 months. Statistical analysis was performed using SPSS version 20, with $p<0.05$ considered significant.
Results: The mean age was 43.36 ± 5.96 years, with slight male predominance (54.4%). There was a significant reduction in plantar fascia thickness from 5.52 mm to 4.96 mm ($p<0.001$) and heel pad thickness from 1.95 mm to 1.80 mm ($p<0.001$). VAS scores decreased significantly from 7.99 to approximately 4 at follow-up ($p<0.001$), indicating substantial pain relief. Heel pad thickness reduction showed a significant negative correlation with pain improvement ($r = -0.394$, $p<0.001$). Complications were minimal, with heel pad atrophy observed in 2.7% of patients.
Conclusion: Ultrasound-guided steroid injection is an effective and safe treatment for plantar fasciitis, providing significant pain relief and structural improvement with a low complication rate.

Keywords*: Plantar fasciitis; Ultrasound-guided injection; Corticosteroid; Heel pain; Plantar fascia thickness; Heel pad thickness; Visual Analogue Scale; Musculoskeletal ultrasonography.*

INTRODUCTION

Plantar fasciitis is one of the most common causes of heel pain, accounting for approximately 10% of running-related injuries and affecting nearly 10% of the general population during their lifetime (1). It is characterised by degeneration and inflammation of the plantar fascia at its origin on the medial calcaneal tuberosity, leading to heel pain that is typically worse during the first steps in the morning or after prolonged rest (2).

The condition predominantly affects middle-aged individuals and is associated with several risk factors, including obesity, prolonged standing, improper footwear, and reduced ankle dorsiflexion (3). Although the exact pathophysiology is debated, current evidence suggests a degenerative process (fasciosis) rather than a purely inflammatory condition (4).

Diagnosis is primarily clinical; however, imaging modalities such as ultrasonography play an important role in confirming the diagnosis and assessing severity. Ultrasonography typically demonstrates increased plantar fascia thickness (>4 mm), reduced echogenicity, and perifascial oedema (5). It is also useful for guiding therapeutic interventions.

Conservative management remains the first-line treatment and includes rest, non-steroidal anti-inflammatory drugs, stretching exercises, orthotics, and physiotherapy (6). However, a subset of patients fails to respond to conservative measures and requires interventional therapy. Corticosteroid injections are widely used due to their potent anti-inflammatory effects and ability to provide rapid pain relief (7).

Ultrasound-guided steroid injections have gained popularity over blind injections due to improved accuracy, better targeting of the pathological site, and reduced risk of complications such as plantar fascia rupture and fat pad atrophy (8). Despite their effectiveness, concerns remain regarding potential adverse effects, particularly heel pad atrophy and recurrence of symptoms (9).

Therefore, this study was undertaken to evaluate the effectiveness of ultrasound-guided steroid injections in patients with plantar fasciitis by assessing changes in plantar fascia thickness, heel pad thickness, and pain scores, along with documenting associated complications and clinical outcomes.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Orthopaedics at BLDE (Deemed to be University) Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka, India. The study was carried out over the period of March 2024 to December 2025.

Study Population and Sample Size

The sample size was calculated using G*Power software version 3.1.9.4, based on comparison of two dependent means (matched pairs). Using preliminary ultrasound data (mean heel pad thickness pre-injection: 1.87 ± 0.24 cm; post-injection: 1.80 ± 0.20 cm), with an effect size of 0.269, alpha error of 0.05, and power of 90%, the required sample size was 147 patients.

Inclusion Criteria

Patients were included if they met the following criteria:

1. Age between 20 and 70 years
2. History of inferior heel pain for ≥8 weeks

Exclusion Criteria

Patients were excluded if they had:

1. Prior local invasive procedures (injections or surgery)
2. Systemic inflammatory or connective tissue disorders
3. Herniated lumbar intervertebral disc
4. History of local trauma
5. Uncontrolled diabetes mellitus

Patient Recruitment and Consent

Eligible patients presenting with chronic plantar fasciitis were recruited from the orthopaedic outpatient department. Written informed consent was obtained after explaining the study details, procedure, risks, and benefits. Participation was voluntary, and confidentiality of patient data was strictly maintained.

Clinical Assessment

All patients underwent a detailed clinical evaluation, including:

- History of heel pain (duration, severity, morning stiffness)
- Assessment of comorbid conditions

- General and systemic examination
- Local examination focusing on tenderness at the medial calcaneal tuberosity

Pain severity was assessed using the Visual Analogue Scale (VAS).

Radiological Assessment

All patients underwent:

1. Plain radiographs (weight-bearing AP and lateral views) to assess bony abnormalities and calcaneal spurs
2. Ultrasonography (6–13 MHz linear probe) to evaluate:

- Plantar fascia thickness (>4 mm considered diagnostic)
- Heel pad thickness
- Echogenicity and perifascial oedema
- Vascularity using Doppler imaging when indicated

Intervention: Ultrasound-Guided Steroid Injection

Under strict aseptic precautions and ultrasound guidance:

- Local anaesthesia with 2% lignocaine was administered
- A 18G needle was inserted using an in-plane technique
- Injection was given superficial to the plantar fascia

Injection composition:

- 1 mL triamcinolone acetonide (40 mg/mL)
- 1 mL 2% lignocaine

Real-time ultrasound ensured accurate placement and distribution.

Post-Procedure Care

Patients were advised:

- Cold application for 48 hours
- Limited weight-bearing for 2 days
- Avoid strenuous activity for 1 week
- Continue conservative measures (footwear modification, stretching exercises)

Follow-Up and Outcome Measures

Patients were followed at:

- 2 weeks
- 3 months

Assessments included:

- VAS pain score
- Ultrasonographic measurement of plantar fascia and heel pad thickness
- Functional outcomes (return to activity/work)
- Complications (infection, fascia rupture, heel pad atrophy)

Data Management and Statistical Analysis

Data were recorded in Excel and analyzed using SPSS version 20.

- Continuous variables: Mean ± SD
- Categorical variables: Frequency and percentage

Statistical tests used:

- Paired t-test (within-group comparisons)
- Independent t-test (between groups)
- Mann–Whitney U test / Wilcoxon test (non-parametric data)
- Chi-square / Fisher's exact test (categorical variables)
- ANOVA / Kruskal-Wallis test (multiple group comparisons)

A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of BLDE University. It adhered to the principles of the Declaration of Helsinki and Good Clinical Practice guidelines. Patient confidentiality was maintained using coded identifiers. Any adverse events were managed as per institutional protocol.

RESULTS AND OBSERVATIONS

From March 2024 to December 2025, the Orthopaedics department at Shri B.M. Patil's Medical College, Hospital, and Research Centre, Vijayapura, evaluated the mechanical properties of the heel pad, plantar fascia thickness, and pain outcome after steroid injection in plantar fasciitis patients. The study involved 147 patients.

Table 1: Demographic Distribution of Study Participants (N = 147)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	30–50	135	91.8
	51–70	12	8.2
	Total	**147**	**100.0**
Mean ± SD	—	—	**43.36 ± 5.96 years**
Gender	Male	80	54.4
	Female	67	45.6
	Total	**147**	**100.0**

The study population predominantly consisted of middle-aged individuals (91.8%), with a mean age of 43.36 ± 5.96 years. There was a slight male predominance (54.4%), although both genders were almost equally represented, indicating no significant gender bias in plantar fasciitis occurrence within this sample.

Table 2: Clinical Characteristics of Study Participants (N = 147)

Variable	Category	Frequency (n)	Percentage (%)
Side Affected	Left	79	53.7
	Right	68	46.3
	Total	**147**	**100.0**
Duration of Symptoms	8–12 weeks	51	34.7
	13–16 weeks	45	30.6
	17–20 weeks	50	34.0
	>20 weeks	1	0.7
	Total	**147**	**100.0**
Mean ± SD (weeks)	—	—	**14.51 ± 3.83**

The left foot was slightly more commonly affected (53.7%) compared to the right (46.3%), indicating no strong side predominance. Most patients presented with symptoms lasting 8–20 weeks, with a mean duration of 14.51 ± 3.83 weeks, suggesting that individuals typically sought treatment after 3–4 months of persistent heel pain.

Table 3: Ultrasonographic Measurements at Different Time Points (N = 147)

Parameter	Pre-injection (Mean ± SD)	2 Weeks (Mean ± SD)	3 Months (Mean ± SD)	p-value
Plantar Fascia Thickness (mm)	5.52 ± 0.29	5.38 ± 0.37	4.96 ± 0.51	<0.001*

Heel Pad Thickness (mm)	1.95 ± 0.05	1.89 ± 0.06	1.80 ± 0.18	<0.001*

*Statistically significant

Table 4: Pain Scores and Complications Among Study Participants (N = 147)

Parameter	Category / Time Point	Frequency (n) / Mean ± SD	Percentage (%)	p-value
VAS Score (Mean ± SD)	Pre-injection	7.99 ± 0.82	—	—
	2 Weeks	4.03 ± 1.2	—	<0.001*
	3 Months	4.14 ± 1.4	—	<0.001*
Complications	Heel pad atrophy	4	2.7	—
	Absent	143	97.3	—
	Total	**147**	**100.0**	—

*Statistically significant

There was a marked and statistically significant reduction in pain, with VAS scores decreasing from 7.99 pre-injection to ~4 at follow-up, indicating nearly 50% pain relief that was sustained at 3 months. Complications were minimal, with only 2.7% of patients developing heel pad atrophy, while the majority (97.3%) had no adverse effects, demonstrating that the procedure is both effective and relatively safe.

Table 5: Correlation of Clinical and Ultrasonographic Variables with Pain Improvement (N = 147)

Variables	Pearson Correlation (r)	p-value
PF Thickness Change (3 months) vs VAS Change (3 months)	0.063	0.452
Heel Pad Thickness Change vs VAS Change (3 months)	-0.394	<0.001*
Duration of Symptoms vs VAS Change (3 months)	-0.047	0.572

***Statistically significant**

No significant correlation was found between plantar fascia thickness change or symptom duration and pain improvement. However, heel pad thickness reduction showed a significant moderate negative correlation with VAS improvement, indicating greater pain relief with greater reduction in heel pad thickness.

DISCUSSION

Plantar fasciitis is a common cause of chronic heel pain, particularly among middle-aged individuals. In the present study, the majority of patients (91.8%) belonged to the 30–50 years age group, with a mean age of 43.36 ± 5.96 years. This finding is consistent with previous studies that have reported a higher prevalence of plantar fasciitis in middle-aged populations due to cumulative mechanical stress and degenerative changes in the plantar fascia (10,11).

A slight male predominance (54.4%) was observed in this study, although the distribution was relatively balanced. Similar findings have been reported in the literature, suggesting that plantar fasciitis affects both genders without a strong predisposition (12). The left side was marginally more affected than the right, but no significant laterality trend was observed, aligning with prior studies indicating that plantar fasciitis does not strongly favour one side (13).

The mean duration of symptoms prior to intervention was 14.51 ± 3.83 weeks, indicating that most patients sought treatment after 3–4 months of persistent pain. This delay is commonly reported and reflects initial reliance on conservative management before seeking interventional therapy (14).

In the present study, ultrasonographic evaluation demonstrated a significant reduction in plantar fascia thickness from 5.52 mm pre-injection to 4.96 mm at 3 months ($p<0.001$). This finding is in agreement with previous studies, which have shown that corticosteroid injections can reduce inflammatory changes and thickness of the plantar fascia (15,16). However, despite this structural improvement, no significant correlation was found between plantar fascia thickness reduction and pain relief.

This suggests that symptomatic improvement may not be solely dependent on anatomical changes, a finding also supported by earlier research (17).

Heel pad thickness showed a statistically significant reduction over time ($p<0.001$), with a moderate negative correlation with pain improvement ($r = -0.394$). This indicates that a greater reduction in heel pad thickness was associated with greater pain relief. While this may reflect the therapeutic effects of steroid injection, it also raises concerns regarding heel pad atrophy as a potential adverse effect. Similar observations have been reported in the literature, where corticosteroid use has been associated with soft tissue atrophy (18).

Pain assessment using the Visual Analogue Scale (VAS) demonstrated a marked reduction from 7.99 pre-injection to approximately 4 at both 2 weeks and 3 months ($p<0.001$), indicating nearly 50% pain relief. These findings are consistent with previous studies that have demonstrated rapid and sustained pain relief following corticosteroid injections (19,20). The sustained improvement at 3 months suggests that ultrasound-guided injection provides not only short-term but also intermediate-term benefits.

The complication rate in this study was low, with heel pad atrophy observed in only 2.7% of patients. No major complications such as plantar fascia rupture or infection, were reported. This supports the safety profile of ultrasound-guided injections, as real-time visualisation allows precise placement of the drug and minimises inadvertent tissue damage (21).

Additionally, no significant correlation was found between duration of symptoms and treatment outcome, indicating that patients benefited from the intervention regardless of symptom chronicity. This finding is comparable to previous studies, which have reported that corticosteroid injections are effective across varying durations of symptoms (22).

Overall, the findings of this study demonstrate that ultrasound-guided steroid injection is an effective and relatively safe modality for the management of plantar fasciitis, resulting in significant pain relief and reduction in plantar fascia thickness. However, the potential for heel pad atrophy highlights the need for cautious use and careful patient selection.

CONCLUSION

Ultrasound-guided steroid injection is an effective and safe treatment for plantar fasciitis, providing significant and sustained pain relief along with a reduction in plantar fascia thickness.
Although heel pad thickness decreased, indicating possible atrophy, complications were minimal. Overall, it is a reliable modality for short- to intermediate-term management with careful monitoring.

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