

Ultrasound-Guided Triamcinolone Acetonide Injection for Patients of Plantar Fasciitis Not Responding to Conservative Management

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Abstract

Background: Chronic plantar fasciitis is one of the main causes of chronic heel pain in younger aged populations with an active lifestyle. Although primary management of plantar fasciitis remains conservative, a subset of patients not responding to the same require invasive methods for effective management. Ultrasound-guided steroid injections offer real-time drug delivery allowing precision as well as confirmation of drug delivery at the site of diseased tissue. This, hence, offers a superior therapeutic outcome and alleviates the risk of heel pad atrophy as is possible with routine palpation-guided blind injections.

Methodology: A hospital based prospective observational study was conducted to assess the effectiveness of Triamcinolone Acetonide injection in chronic plantar fasciitis when given under ultrasound scan. A total of fifty consecutive patients aged 20 to 60 years who failed to respond to conservative management were included in the study. The patients received a 50:50 drug mixture of Triamcinolone Acetonide injection (20mg) and 2% Xylocaine 2ml under ultrasound scan. Each patient was followed-up at Week 2 and Week 6 post-injection wherein the effectiveness of treatment was assessed in terms of symptomatic pain relief and resolution of plantar fascia thickness.

Results: The mean score on Visual Analogue scale of patients at the time of entry to the study was 71.54 mm and the mean plantar fascia thickness as measured on ultrasound was 5.33 mm. After six-weeks of injection, the mean Visual Analogue Score had reduced to 33.83 mm and corresponding mean plantar fascia thickness had reduced to 3.60 mm. The average percentage reduction in mean visual Analogue Score was 52.69%.

Conclusion: The ultrasound-guided single-shot steroid injection is an effective modality of treatment in chronic plantar fasciitis. The ultrasound not only offers real-time scans for precise drug delivery, thus alleviating the risks of plantar fascia rupture or heel pad atrophy, but also acts as a reliable tool for objective confirmation of clinical resolution.

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Introduction

The plantar fascia is a thickened fibrous aponeurosis extending from the inferior aspect of the calcaneus to the plantar plates of metatarsophalangeal joints and bases of proximal phalanges of the toes [1]. Anatomically, plantar fascia is divided into three parts (i) Medial Band (ii) Central Band and (iii) Lateral Band. Central band represents the thickest part of fascia & is also most prone to develop inflammatory changes. Plantar fasciitis is the pain caused by degenerative irritation of the plantar aponeurotic band at the site of its insertion. Pathologically, damage at

calcaneal-fascial interface secondary to repetitive trauma is noticed. Though biomechanical dysfunction is believed to be the commonest etiology; infectious, neoplastic, arthritic, neurologic, traumatic, and other systemic conditions are other causes of plantar fasciitis. Often it presents as post-static dyskinesia i.e., heel pain in morning or after rising from prolonged sitting [1]; pain being most strikingly present at the medial plantar prominence of the calcaneus, but it may radiate proximally in severe forms of plantar fasciitis. Though initial episodes of pain may lessen

as one walks, chronic plantar fasciitis may be severe enough to cause pain even at rest, significantly affecting the activities of daily living. Eventually, chronic heel pain along with secondary issues in the lower limb may cause the patient to limp. Besides pain, patients may also experience stiffness in the foot; few others may complain of localized swelling in the heel as well. While examining the patient, palpation of medial calcaneal tubercle may reproduce the pain of plantar fasciitis. Other manoeuvres that reproduce the symptoms include passive dorsiflexion of toes i.e. the windlass test and asking the patient to toe-walk [2].

The diagnosis of plantar fasciitis is primarily clinical based on its typical presentation. However, some patients may not have typical features and hence may require further investigations to rule out other causes of chronic heel pain. Plain radiographs of foot depict calcaneal spur while lateral radiographs of foot may rule out the possibility of stress fractures. Besides, Magnetic Resonance Imaging can provide direct imaging of plantar fascia and may also help in identifying other possible soft tissue lesions that could possibly be contributing to the chronic heel pain. Electromyography may be helpful if a neurogenic cause is suspected. Alternatively, a high resolution ultrasound is an easy and reliable diagnostic tool for diagnosis of plantar fasciitis. Under ultrasound, a normal plantar fascia appears as a fibrillar ligamentous structure with an average maximal thickness in central band reported as 4.0mm and lateral and medial band thickness reported as 2.3mm and 0.6mm respectively [3].

The fibrillar nature of normal plantar fascia is due to hyperechoic Type I collagen fibres embedded in a hypoechoic background [3]. In plantar fasciitis, ultrasound pictures a fascia with loss of fibrillar structures that has increased thickness greater than 4.0mm with or without peri-fascial collections or calcifications [3]. By allowing direct visualization of affected structures, ultrasound can therefore provide an accurate, highly sensitive, low-cost, radiation free, easy to perform diagnostic modality for confirming diagnosis of plantar fasciitis. Tsai [4] concluded that ultrasound had a sensitivity of 91.9 percent and a specificity of 90.5 percent in the diagnosis of plantar fasciitis. The authors also concluded that an objective assessment would allow the physicians to assess individual treatment regimens, which makes it a suitable option for follow-up as well.

Treatment is primarily conservative in most cases of plantar fasciitis; literature reports that more than 80% of patients respond well to conservative management [2]. Commonly entailed treatment options include (i) Physiotherapy (ii) Splint wears and modified shoes (iii) Local ice packs (iv)

NSAIDs (non-steroidal anti-inflammatory drugs). Night-splints help in maintaining a neutral 90 degrees foot-leg angle to provide constant passive stretching of the Achilles tendon and plantar fascia to prevent micro-trauma secondary to plantar flexion that occurs naturally during sleep. Besides, supportive foot orthotics also help in symptomatic improvement. Anti-inflammatory medications like NSAIDs can be useful as adjunct to other modes of management. However, daily doses used in the management are associated with gastrointestinal sequelae, limiting significantly patient's compliance to drugs. Newer treatment modalities [5] include: a) Platelet-rich plasma injections- A natural source of reparative growth factors to aid in healing, platelet-rich plasma can be used to restore and regenerate the degenerated plantar fascia. High cost and state-of-art equipment limit the use of this modality in our set-up. b) Autologous blood injections- Instead of plasma, this makes use of whole blood and is believed to act like platelet rich plasma. However, not enough studies have been conducted yet to assess its effectiveness. c) Extracorporeal shock wave therapy- A newer modality that may be considered in patients not responding to other management modalities and are reluctant for open surgical procedures. d) Surgical interventions in the form of plantar fasciotomy.

Corticosteroid injections remain by far the most popular treatment option for chronic plantar fasciitis where conservative treatment approaches fail. Repetitive trauma to the plantar fascia causes degenerative changes leading to traction periostitis and micro-tears causing pain. Corticosteroids act by reducing thickness of plantar fascia and inflammation that may be associated with it. Corticosteroid injections are commonly guided by the palpation method i.e. palpation of the tender point in the heel to guide the site of injection. Though widely common among orthopedicians, blind injections may mistakenly allow drugs to be delivered in the fat pad of heel or too deep into the body of plantar fascia. This eventually poses risk of debilitating heel pad atrophy or rupture of plantar fascia respectively. This underlines the significance of ultrasound guided steroid injections wherein a real-time scan allows direct visualization of affected structures and thus allows visualization of spread of injected drug. Hence, the accuracy of drug delivery at the diseased site improves, which overall results in better therapeutic efficacy. Ultrasound guided steroid injections therefore present a promising role in the management of chronic plantar fasciitis.

Materials & Methods

A hospital based prospective observational study was conducted over a period of 18 months after approval from the Ethical Committee Board, in the Department of Anaesthesiology, Critical Care and

Pain Management in association with the Department of Orthopaedics, Government Medical College & Associated Hospitals, and Srinagar. The aim of our study was to assess the effectiveness of ultrasound-guided Triamcinolone acetonide injection in plantar fasciitis in patients not responding to conservative treatment.

The objectives of our study were to (i) assess symptomatic pain relief in terms of visual analogue scale (VAS) score after ultrasound-guided triamcinolone acetonide injection with subjective assessment score recorded at zero, two weeks and six weeks after injection (ii) to note any post-injection complications and (iii) to study alleviation of need for surgery.

Fifty consecutive patients with unilateral plantar fasciitis, aged between 20 to 60 years, with chronic pain interfering with daily activities of life and not responding to conservative measures of treatment from the past six months were included in the study. The patients were received from the out-patient department of Bone & Joint Hospital, Barzulla. Clinical assessment and biochemical markers were used to rule out any possibility of systemic inflammatory disease, connective tissue disease, herniated intervertebral disc of lumbar spine, or any coagulation abnormality before commencement of procedure. Predesigned proformas were used to record history and physical examination of patients after taking informed consent for the procedure.

Visual Analogue scale(VAS) was used to assess the intensity of pain at day zero which was marked by patients on a 10 cm continuum scale where zero represents no pain while ten represents the worst pain in a patient's experience. For the procedure, patients were put in the prone position with feet hanging over the edge of the examination table. Real-time ultrasound with a 14-MHz linear array transducer was used to assess plantar fascia. The maximum thickness of plantar fascia was measured on a longitudinal view of heel (along an imaginary line connecting midline the midpoint of heel and the second toe). The plantar fascia thickness greater than 4mm on diagnostic ultrasound was taken as confirmation of plantar fasciitis. Any changes in the echogenicity of plantar fascia at calcaneal insertion were assessed. Subsequently, the heel to be injected was prepared with povidone-iodine. A 20 or 22-gauge needle was connected with a 5-mL syringe containing the desired drug concentration.

The needle was inserted through posterior approach or medial approach into heel into the plane between the fat pad and plantar fascia under ultrasound guidance. A freshly prepared 50:50 drug mixture of Triamcinolone injection acetonide (20mg) and 2% Xylocaine 2mL was then administered slowly. The site of insertion of injection was the site of

maximum width of hypoechoic area along the length of plantar fascia. The dispersal of hyperechoic injection admixture was confirmed on real-time ultrasound scan (6). Patients were asked to follow-up for serial assessment at 2 weeks and 6 weeks post steroid injection. On follow-ups the pain score along with the corresponding plantar fascia thickness were re-assessed and recorded on the proformas.

Statistical Analysis: The data was entered in a Microsoft Excel spreadsheet & continuous variables were summarized as mean and standard deviation. Categorical variables were summarized as frequency & percentage. Categorical data was compared using chi-square test and Student's paired T-test was used to determine association between continuous variable and categorical variable. p-Values less than 0.05 were considered statistically significant.

Results & Discussion

Ultrasound is an emerging tool for confirming the diagnosis of plantar fasciitis. It can visualize the thickening and hypoechoicity of the diseased plantar fascia besides being used for real-time steroid injections allowing precision and hence, better outcomes. Kane et. al [7] used ultrasound guided steroid injections for management of recalcitrant plantar fasciitis. In their study, four of five patients showed complete clinical response after ultrasound guided injections, when palpation guided injection had failed.

Besides, Yucel et. al., compared ultrasound, palpation, & scintigraphy-guided steroid injections for the treatment of plantar fasciitis & concluded that real-time ultrasound guidance improves the accuracy of steroid injections resulting in better therapeutic outcome along with preservation of mechanical properties of heel pad [8].

In our hospital set-ups, chronic plantar fasciitis was being managed mostly with palpation-guided triamcinolone acetonide injections. But with the advent of radiologic confirmation and real-time injections under ultrasound guidance, the management of chronic plantar fasciitis has shown advancements and better outcomes. We conducted the study on ultrasound-guided steroid injections in chronic plantar fasciitis not responding to conservative management to assess the effectiveness of the same by assessing the symptomatic pain relief over a period of six weeks after intervention.

In our study, a total of fifty patients with chronic plantar fasciitis were enrolled; 11 males and 39 females. The age range was 28 to 47 years with mean age of 37.76 ± 5.18 years. The average weight of the patients included in the study was 65.52 ± 7.24 kgs with the weights ranging from 54

to 84 kgs. The mean pain score of patients at the time of entry to the study was 71.54 ± 8.08 mm on Visual Analogue Pain scale and the mean plantar fascia thickness before ultrasound guided steroid injection was 5.33 ± 0.7 mm. The maximum pain

score noted at the time of entry of patients was 88 mm and the maximum plantar fascia thickness noted on Day zero 6.9 mm. Table 1 summarizes the demographic and clinical findings of our study subjects.

Table 1: Demographic details and clinical findings of patients included in the study

Parameter	Minimum value	Maximum value	Mean	Standard Deviation (SD)
Age (years)	28	47	37.76	5.18
Weight (kgs)	54	84	65.52	7.24
Duration of Symptoms (weeks)	8	36	17.56	7.89
Duration of conservative treatment (weeks)	6	30	13.42	7.41
VAS pain score on Day Zero (mm)	60	88	71.54	8.08
VAS pain score after 2 weeks of injection (mm)	20	66	42.58	10.36
VAS pain score after 6 weeks of injection (mm)	20	55	33.84	9.03
Plantar Fascia Thickness on Day Zero (mm)	4.2	6.9	5.34	0.73
Plantar Fascia Thickness after 2 weeks (mm)	2.8	4.6	3.65	0.48
Plantar Fascia Thickness after 6 weeks (mm)	3	4.3	3.6	0.36

(VAS: Visual analogue scale)

In a study conducted by Shiotani et. al., the authors found that the shear wave velocity, which reflects the stiffness of plantar fascia, was higher in females than males [9].

The authors hence concluded that females tend to have more prone morphology for developing

plantar fasciitis than males. Although females accounted for approximately 78% of our subjects, indicating a higher frequency of cases involving females, there were no significant differences in the severity of plantar fascia symptoms between females and males, with respect to pain severity and inflammation of plantar fascia. (Table 2).

Table 2: Table shows mean values of pain scores and plantar fascia thickness in enrolled male and female patients before the injection. Our study found no statistically significant correlation between the severity of disease and specific gender.

Clinical Parameter	Gender	Number of patients	Mean value	Standard Deviation (SD)	p-value
VAS pain score at Day Zero (mm)	Male	11	71.27	7.48	0.9
	Female	39	71.62	8.34	0.9
Plantar Fascia Thickness at Day zero (mm)	Male	11	5.23	0.84	0.57
	Female	39	5.37	0.71	0.57

(VAS: Visual analogue scale)

After six weeks of follow up, the mean VAS score had reduced to 33.83 ± 9.02 mm & corresponding mean plantar fascia thickness had reduced to 3.60 ± 0.36 mm, confirming the efficacy of ultrasound guided steroid injections (see Figure 1). Further, when comparing the severity of pain with the thickness of plantar fascia, a statistically significant correlation was found between the two, as shown in Table 3, re-emphasizing the sensitivity of ultrasound in the diagnosis of plantar fascia thickness.

Table 3: Table compares the mean values of pain scores and plantar fascia thickness of patients before injection of the combination drug and six weeks after receiving the injection under ultrasound guidance. P-Value <0.001

Clinical Parameter	Mean	Standard Deviation (SD)
VAS pain score at Day Zero (mm)	71.54	8.08
VAS pain score after 6 weeks of follow-up (mm)	33.84	9.03
Plantar Fascia Thickness at Day zero (mm)	5.34	0.73
Plantar Fascia Thickness after 6 weeks of follow-up(mm)	3.6	0.36

(VAS: Visual analogue scale)

Our results showed similar efficacy as observed by Andrew McMillan [10] who, in his randomized controlled trial concluded that ultrasound-guided steroid injections offer statistically significant relief in pain over placebo groups. Similarly, in another

study, Hakan et al [11] found a strong correlation between the changes of plantar fascia thickness & VAS values in their study. However, a few studies have suggested that the benefits of steroid

injections tend to remain only for a short term between 4 weeks to 12 weeks post-injection [12].

As can be seen in Figure 1 a dramatic decrease in heel pain was observed from Day Zero to 2 weeks beyond which the decrease in pain scores is more gradual and subtle. As a result, we may expect the effectiveness of steroid injections to fade off with time. Therefore, further long-term studies are necessary to establish the sustained efficacy of ultrasound-guided steroid injections in the management of chronic plantar fasciitis. Nonetheless, since none of the patients included in the study presented with the features of heel pad atrophy, it reiterates the fact concluded by Tsai et.al., [4] that guidance under ultrasound allows effective management of plantar fasciitis without significant deterioration of the mechanical properties of the heel pads. The patients enrolled in our study complained of pain during injection which got relieved spontaneously within a few minutes, implicating that there is no need to provide any added analgesia for pain on injection. Besides, our study used a lower dose of steroid injection for heel injection of 20 mg, while the usual standard dose of Triamcinolone acetonide injection for blind injections used in our hospital was 40mg. This brings us to the conclusion that under ultrasound guidance, the total dose of a drug needed for pain alleviation is also reduced. It can be explained by the fact that ultrasound allows real-time scan while injection and thus, a specific amount of drug can be delivered in the maximum area of inflammation. Also, mixing of steroid with local anaesthetic xylocaine allows prolongation of duration of action of steroid by causing vasoconstriction & delaying clearance [13]. Furthermore, our procedure offers a significant advantage over conservative management, as the single-shot injection eliminates concerns about patient compliance, providing a more reliable treatment outcome. At the end of treatment, out of fifty patients enrolled, only three patients had a VAS score of 50 mm or greater and three patients had plantar fascia thickness greater than 4 mm at 6 weeks of follow-up. Moreover, only one patient reported difficulty in walking after injection which had resolved at 2 weeks of follow up. No other side effect was noted in any other patient. Of note, no patient presented with heel pad atrophy after ultrasound-guided steroid injection.

From this study, we can hence conclude that ultrasound-guided steroid injections in plantar fasciitis is an effective modality of treatment in patients not responding to conservative management and helps alleviate the risks of plantar fascia rupture or heel pad atrophy as is possible with blind injections. We also conclude that ultrasound is a reliable diagnostic tool for confirming diagnosis of plantar fasciitis. Besides,

we also confirmed that ultrasound examination of plantar fascia thickness can be used to assess the effectiveness of steroid injections in the follow-up period of plantar fasciitis patients.

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