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Original Research Article

Comparison of steroid injection and dextrose (25%) injection in the treatment of plantar fasciitis

Rahul Gopalkrishna Puranik[1], Vishal Anand Mangwalkar[1]*, Pravin Vasant Londhe[1], Mohit Arun Kakad[1]

[1]Dept. of Orthopaedics, Byramjee Jeejeebhoy Government Medical College (BJGMC) and Sassoon General Hospital, Pune, Maharashtra, India

Abstract

Background: Plantar fasciitis is a common cause of heel pain, affecting a significant proportion of population, particularly athletes and middle-aged individuals. While corticosteroid injections have been widely used for symptom relief, concerns over complications have led to exploration of alternative treatments such as dextrose injections.

Aims & Objective: This study aims to compare the efficacy and safety of steroid injections verses dextrose 25% injections in the treatment of plantar fasciitis by assessing pain reduction, functional improvement, and structural changes in the plantar fascia.

Materials and Methods: A comparative observational study was conducted at a tertiary care hospital. Patients diagnosed with plantar fasciitis were randomly assigned to receive either corticosteroid or dextrose injection. Clinical outcomes were measured using the Visual analogue score (VAS) for pain, the American Foot and Ankle score (AFAS) for functional improvement and ultrasound-based measurement of plantar fascia thickness before and after 12 weeks of treatment.

Results: Both treatment groups showed a significant reduction in pain and improvement in functional outcomes. The steroid group demonstrated rapid pain relief, whereas the dextrose group exhibited sustained long-term benefit. At 12 weeks, plantar fascia thickness was similarly reduced in both groups, with no statistical difference between them.

Conclusion: Both steroid and dextrose injections are effective in managing plantar fasciitis. While steroid provide faster symptom relief, dextrose offers sustained benefits with fewer complications, making it a promising alternative for long-term management.

Keywords: Plantar fasciitis, Steroid injection, Dextrose 25% injection.

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1. Introduction

Plantar fasciitis is a prevalent cause of heel pain, affecting about 10% of the population over a lifetime, especially runners and middle-aged adults.[1] It involves inflammation and degeneration of the plantar fascia, leading to impaired daily activities and reduced quality of life.[2] Risk factors include obesity, prolonged standing, improper footwear, and biomechanical imbalances such as flat feet or high arches.[3,4]

Treatment primarily focuses on symptom relief and restoring function. Conservative measures include rest, NSAIDs, and physical therapy.[5] Persistent cases often receive corticosteroid injections, which provide short-term pain relief but risk complications like fascia rupture and fat pad atrophy.[6,7] Hypertonic dextrose injections, an alternative, aim to stimulate healing via a mild inflammatory response, potentially strengthening the fascia.[8,9] Some studies suggest dextrose injections offer comparable or superior long-term pain management and functional improvement compared to steroids.[10] However, further high-quality trials are needed to confirm these findings.[11]

Patient-specific factors, including symptom duration, severity, and comorbidities, should guide treatment selection.[12] Comparing steroid and dextrose injections is crucial for optimizing plantar fasciitis management. This study aims to provide comprehensive insights into their

*Corresponding author: Vishal Anand Mangwalkar
Email: vmangwalkar@gmail.com

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efficacy and safety, influencing clinical practices and patient outcomes.[13]

2. Objectives

1. Compare steroid and dextrose (25%) injections for pain relief over 12 weeks.
2. Compare steroid and dextrose (25%) injections for functional improvement over 12 weeks.
3. Evaluate the impact of both the injections on patient mobility and quality of life.

3. Materials and Methods

This study was structured as a comparative observational study to assess the efficacy and safety of two different treatments for plantar fasciitis: 25% dextrose injections and steroid injections. This study design was chosen to provide a rigorous comparison between the two interventions by systematically measuring outcomes such as pain reduction, functional improvement, and adverse effects.

The study was conducted in the outpatient clinic of the Orthopaedics Department at a tertiary care hospital. Study covered all phases from initial planning and participant recruitment to final follow-up evaluations.

3.1. Inclusion criteria

Participants were required to meet the following criteria:

1. Individuals aged 18 years or older diagnosed with plantar fasciitis.
2. Diagnosis was made based on the international statistical classification of diseases and related health problems (ICD) criteria, which included:
   a. Pain in the plantar medial heel region upon palpation.
   b. Pain that worsened after inactivity and with prolonged weight-bearing.
   c. Pain triggered by increased weight-bearing activities.

3.2. Exclusion criteria

To ensure participant safety and data integrity, the following criteria were applied:

1. Pregnancy and lactation
2. Individuals who had received systemic or local steroid within the past three months
3. Individuals who had received dextrose injections within the past three months
4. Patients with rheumatic or connective tissue diseases, Achilles tendinopathy, infections, or endocrine conditions were excluded
5. Those with foot pain due to arthritis, trauma, neurological conditions, previous heel surgeries, or fractures were excluded
6. Individuals with flat feet or any deformity were excluded.

3.3. Sample size and sampling method

The sample size was calculated to estimate the minimum participants needed to detect a statistically significant difference between the two groups, with a confidence level of 95% and an absolute precision of 20%. Based on previous studies analysing plantar fascia thickness reduction, a minimum of 44 participants was required. To account for potential dropout, the sample size was increased by 10%, resulting in a total of 50 participants.

Purposive sampling was employed, targeting patients diagnosed with plantar fasciitis visiting the orthopaedics outpatient department. Participants were randomly assigned to one of two groups in a 1:1 ratio using a computer-generated randomization sequence, ensuring unbiased assignment. Each group consisted of 25 participants:

Group A (Dextrose Injection Group): Received 2 ml of 25% dextrose injections at the intersection of extension of posterior border of medial malleolus and palpable inferior border of calcaneus and at maximum tenderness site in the plantar fascia.

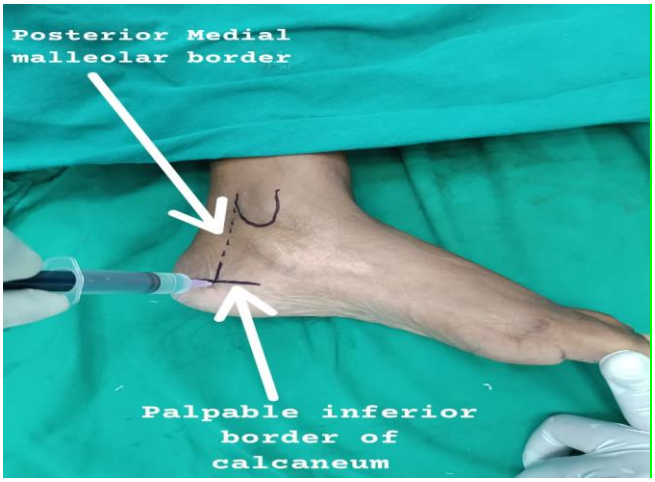

Figure 1: Injections at the intersection of extension of posterior border of medial malleolus and palpable inferior border of calcaneus

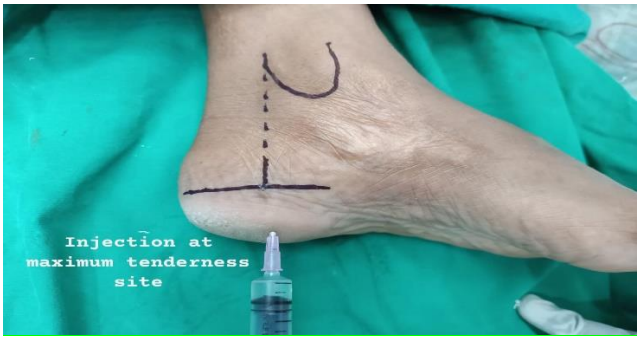

Figure 2: Injection at maximum tenderness site

Group B (Steroid injection Group): Received 40 mg of triamcinolone acetonide mixed with 1 ml of normal saline, injected at the intersection of extension of posterior border of medial malleolus and palpable inferior border of calcaneus and at maximum tenderness site in the plantar fascia. (**Figure 2**)

3.4. Study parameters and assessment methods

1. Primary parameters assessed included:
   a. Pain severity: Measured using the Visual Analog Scale (VAS), ranging from 0 (no pain) to 10 (worst possible pain).
   b. Functional outcomes: Evaluated using the American foot and ankle score (AFAS), assessing pain on first step in the morning and after continuous walking, maximum walking distance.
   c. Safety profiles: Adverse effects such as infection, heel pad atrophy, or plantar fascia rupture were documented.
2. Secondary parameters included plantar fascia thickness, measured via ultrasound at baseline and after 12 weeks.
   a. All the above parameters were also measured before giving injection, it was made sure that both the study groups were comparable at the start of the study.

3.5. Study procedure

Upon recruitment and informed consent, participants were randomly assigned to one of the two treatment groups. Injection administration was standardized to ensure consistency. In Group A, 2 ml of 25% dextrose was injected using a 27-gauge needle at the maximum tenderness sites under aseptic conditions. In Group B, 40 mg/1 ml of triamcinolone acetonide mixed with 1 ml of normal saline was administered at comparable points.

Post-injection care included reducing weight-bearing activities for 48 hours, using cold packs for swelling, and taking paracetamol for pain management. Follow-ups were scheduled at 2, 4, 6, 8, 10, and 12 weeks post-treatment to assess progress and administer follow-up questionnaires.

1.6. Data collection and analysis

Data collection was meticulously planned. At baseline, demographic information, medical history, and initial pain and functional status were recorded. During follow-ups, pain levels (VAS), functional outcomes (AFAS), and maximum walking distance (meters) were assessed. Adverse events were monitored throughout the study, and plantar fascia thickness was measured via ultrasound at baseline and 12 weeks.

Statistical analysis utilised various methods to evaluate treatment effectiveness and safety

1. Repeated Measures ANOVA: Used to assess changes over time within each group and between groups at follow-up points.
2. Mann-Whitney U Test: Used to compare baseline and post-treatment outcomes between groups.
3. Paired T-Tests: Analysed pre- and post-treatment plantar fascia thickness within groups.
4. Independent T-Tests: Compared plantar fascia thickness reduction between groups.

A p-value of <0.05 was considered statistically significant. Statistical analyses were performed using SPSS software, ensuring comprehensive data handling. Descriptive statistics (mean, standard deviation) summarized demographic and clinical characteristics. Bar graphs and line charts visually represented trends and data changes over time.

4. Results

1. Gender distribution among study participants
   a. The study involved 50 participants, with a gender distribution of 64% female and 36% male. This shows that plantar fasciitis is more commonly seen in females as compared to males.
   b. In the dextrose group, 68% (17/25) were female and 32% (8/25) male. In the steroid group, 60% (15/25) were female and 40% (10/25) male. The p-value (0.556) indicates no significant gender-based distribution difference, confirming comparability between groups.
2. Age distribution among study participants
   a. Mean age was 44.36(±8.8) years in the dextrose group and 42.76(±12.3) years in the steroid group. The p-value (0.600) shows no significant difference in age distribution, confirming comparability.
3. Side to which injection administered among study groups
   a. In the dextrose group, 52% (13/25) received injections on the left and 48% (12/25) on the right. In the steroid group, 44% (11/25) received left-side injections and 56% (14/25) on the right. The p-value (0.571) confirms no significant difference, ensuring comparability.

Comparability of all the study parameters at the start of the study before giving injection in both groups.

Baseline VAS scores, AFAS, walking distance, and plantar fascia thickness were similar across groups, with no significant differences. Steroids showed a slight trend toward increased walking distance and reduced fascia thickness, but differences were not statistically significant. Both groups were comparable at study initiation.

Table 1: Various study parameters at the start of study for each combination of injection type and side

Study parameters at 0 weeks	Dextrose		Steroid		p-value
	Left	Right	Left	Right	
Pain on first step in the morning Visual Analogue Score (VAS) (1-10) Mean(±SD)	9.4(±0.8)	9.5(±0.7)	9.3(±1.1)	9.4(±0.6)	0.946
Pain on continuous walking Visual Analogue score (VAS) (0-10) Mean(±SD)	8.8(±1.0)	9.0(±1.1)	8.7(±1.3)	8.3(±1.1)	0.35
Maximum walking distance (in meters) Mean(±SD)	20.1(±10.5)	19.6(±7.5)	24.4(±14.4)	27.5(±12.5)	0.581
American Foot and Ankle Score (AFAS) Mean(±SD)	59(±3.8)	55.2(±6.3)	56.8(±7.1)	59.4(±3.5)	0.038
Plantar Fascia thickness 1 cm distal to insertion (mm) Mean(±SD)	7.05(±1.38)	6.84(±1.44)	6.96(±1.53)	6.34(±1.08)	0.584

1. Comorbidities among study participants
   a. Among the dextrose group, 64% had no comorbidities, while 36% had conditions like DM or HTN. In the steroid group, 68% had no comorbidities, while 32% had similar conditions. The p-value (0.765) indicates no significant difference, confirming comparability.
2. Comorbidity in relation to Injection given among study participants
   a. Among the dextrose group, 32% had DM, 8% had HTN, and 64% had no comorbidities. In the steroid group, 28% had DM, 12% had HTN, and 68% had no comorbidities. The p-value (0.874) indicates no significant difference, confirming comparability.
3. Pain on first step in the morning in both the study groups
   a. The study presents group statistics for Visual Analogue Score (VAS) pain evaluations over a series of weeks. The following table and graph denote the effect of dextrose and steroid injection over pain on first step in the morning over the period of 12 weeks.

Table 2: Pain on first step in the morning visual analogue score (VAS) among study groups

Follow up duration	Dextrose Group Mean(±SD)	Steroid Group Mean(±SD)	p-value
0 weeks	9.44(±0.71)	9.32(±0.85)	0.592
2 weeks	5.04(±0.88)	3.40(±0.81)	0.000
4 weeks	3.64(±0.70)	2.44(±0.71)	0.000
6 weeks	2.52(±0.59)	1.68(±0.74)	0.000
8 weeks	1.72(±0.61)	0.96(±0.5)	0.000
10 weeks	0.96(±0.46)	0.24(±0.43)	0.000
12 weeks	0.28(±0.46)	0.00(±0.00)	0.004

VAS scores were initially high in both groups (p=0.592). Steroid injections led to a greater reduction in pain at each 2-week interval, with a mean VAS of 0.00 at 12 weeks, while dextrose patients had 0.28. Significant differences (p<0.001) from week 2 confirm the faster and superior pain relief with steroids. Dextrose provided comparable relief by 12 weeks.

Table 3: Pain on continuous walking Visual Analogue Score (VAS) among study groups

Follow up duration	Dextrose Group (Mean±SD)	Steroid Group (Mean±SD)	p-value
0 weeks	8.92(±1.03)	8.48(±1.15)	0.164
2 weeks	5.08(±0.86)	2.28(±0.61)	0.000
4 weeks	3.36(±0.63)	1.56(±0.5)	0.000
6 weeks	2.16(±0.55)	0.56(±0.58)	0.000
8 weeks	1.52(±0.51)	0.28(±0.45)	0.000
10 weeks	0.20(±0.40)	0.00(±0.00)	0.018
12 weeks	0.00(±0.00)	0.00(±0.00)	

VAS scores were initially high in both groups (p=0.164). By week 2, the steroid group showed significantly lower pain scores (2.28 vs. 5.08, p<0.001). Steroids maintained superior pain reduction at weeks 4, 6, and 8. By week 10, the difference narrowed (0.200, p=0.018), but steroids remained more effective. Dextrose achieved comparable pain relief by week 12.

Table 4: Maximum walking distance (in meters) among study groups

Follow up duration	Dextrose Group (Mean±SD)	Steroid Group (Mean±SD)	p-value
0 weeks	19.84(±9.01)	26.12(±13.20)	0.055
2 weeks	31.60(±9.86)	54.40(±15.02)	0.000
4 weeks	44.00(±9.24)	68.40(±13.74)	0.000
6 weeks	60.00(±9.12)	83.20(±10.69)	0.000
8 weeks	77.20(±9.36)	96.00(±7.07)	0.000
10 weeks	90.80(±7.02)	99.60(±1.38)	0.000
12 weeks	97.40(±4.35)	100.00(±0.00)	0.004

At baseline, the steroid group had a higher mean walking distance (26.12m) than the dextrose group (19.84m). By week 2, steroids significantly improved walking distance (54.40m vs. 31.60m, p<0.001). This trend continued, with steroids reaching 100.00m and dextrose 97.40m by week 12.

Steroids led to faster mobility gains, while dextrose achieved comparable results by 12 weeks.

American Foot and Ankle Score (AFAS) over 12 weeks demonstrates a consistent improvement in patients treated with steroid injections compared to those receiving dextrose.

Table 5: American foot and ankle score (AFAS) among study groups

Follow up duration	Dextrose Group (Mean±SD)	Steroid Group (Mean±SD)	p-value
0 weeks	57.16(±5.38)	58.24(±5.40)	0.482
2 weeks	70.00(±3.92)	77.00(±4.54)	0.000
4 weeks	78.00(±4.38)	85.52(±3.05)	0.000
6 weeks	85.56(±3.51)	88.00(±2.04)	0.004
8 weeks	87.68(±2.09)	89.48(±0.51)	0.000
10 weeks	88.84(±1.93)	89.88(±0.3)	0.011
12 weeks	89.44(±2.00)	90.00(±0.00)	0.168

The steroid group showed faster improvement in AFAS scores, reaching 77.00 at week 2 vs. 70.00 for dextrose. By week 12, steroids achieved a perfect score of 90.00, while dextrose peaked at 89.44. Significant differences emerged from week 2 ($p<0.001$), narrowing by week 10, indicating steroids' faster effect, though both treatments reached similar functional outcomes by 12 weeks.

Table 6: Plantar fascia thickness 1 cm distal to insertion (in mm) among the study groups

Follow up duration	Dextrose Group (Mean±SD)	Steroid Group (Mean±SD)	p-value
0 weeks	6.948(±1.38)	6.612(±1.30)	0.382
12 weeks	2.492(±0.55)	2.356(±0.47)	0.354

Mean plantar fascia thickness at baseline was 6.948mm (dextrose) and 6.612mm (steroids). By week 12, both groups showed significant reductions, with dextrose at 2.492mm and steroids at 2.356mm. Differences remained statistically insignificant ($p=0.354$), confirming both treatments provide similar improvements in fascia thickness.

5. Discussion

This study compared the effectiveness of steroid injections and 25% dextrose injections in treating plantar fasciitis, focusing on pain relief, functional mobility, and plantar fascia thickness over 12 weeks. The study directly compares these treatment modalities using the Visual Analogue Scale (VAS) for pain, the American Foot and Ankle Score (AFAS) for functional outcomes, and ultrasound for plantar fascia thickness measurement. Findings can guide healthcare providers in selecting the most suitable treatment based on efficacy and safety.

A gender imbalance was observed, with females comprising 64% of participants and males 36%, consistent with previous studies on plantar fasciitis. In the dextrose group, 68% were female and 32% male, while in the steroid group, 60% were female and 40% male ($p = 0.556$), indicating no statistically significant difference between groups. Raissi et al. also reported a female predominance (62%) in their study comparing dextrose and corticosteroids for plantar fasciitis.[14] Factors like foot biomechanics, footwear, and hormonal influences may contribute to the higher prevalence among women.[15]

Participants were equally distributed between dextrose and steroid groups, minimizing bias. In the dextrose group, 52% received injections on the left and 48% on the right, while in the steroid group, 44% received injections on the left and 56% on the right ($p = 0.571$), confirming no significant difference in treatment distribution. Lai et al. found that foot side does not significantly affect treatment efficacy,[15] a finding supported by Akram et al.[16] and Varma et al.[17] While some studies suggest foot dominance might influence plantar fasciitis severity, it does not appear to affect treatment response.[18]

Comorbidities were documented to assess their potential impact. In the dextrose group, 32% had diabetes (DM), 8% had hypertension (HTN), and 64% had no comorbidities, whereas in the steroid group, 28% had DM, 12% had HTN, and 68% had no comorbidities ($p = 0.874$), suggesting no significant differences between groups. Biswas et al. found that comorbidities like diabetes do not significantly alter corticosteroid response, though diabetic patients experience longer recovery times.[19]

VAS scores assessed pain intensity at various intervals. At the start of study, both groups reported significant pain depicted by VAS score (dextrose: 9.44; steroid: 9.32), with no significant difference. Over 12 weeks, both groups experienced significant pain reduction, with the steroid group reporting lower scores at each interval. By week 12, the steroid group reached a VAS score of 0.00, while the dextrose group had a residual 0.28 (**Table 2**). Raissi et al. found corticosteroids provided significantly lower pain scores at two weeks, though differences diminished by 12 weeks.[14] Lai et al. reported corticosteroids were more effective for short-term pain relief but dextrose had better long-term efficacy.[15] Ryan et al. observed significant pain reduction with dextrose, particularly in chronic cases.[20] While steroids provide quicker relief, dextrose remains an effective alternative.

Pain during walking was also assessed. At the start of study, both groups reported severe pain (dextrose: 8.92; steroid: 8.48). By week 2, the steroid group had significantly lower scores (2.28 vs. 5.08), achieving 0.00 by week 10, while the dextrose group reached 0.00 by week 12 (**Table 3**). Raissi et al. observed corticosteroids provided greater early pain relief during sports activities but were comparable to dextrose by 12 weeks.[14] Steroid injections offer faster

functional recovery, though dextrose remains viable for long-term pain management.

Maximum walking distance was another key functional measure. At the start of study, the steroid group averaged 26.12 meters and the dextrose group 25.84 meters. By week 2, the steroid group nearly doubled walking distance to 54.40 meters, while the dextrose group increased to 31.60 meters. By week 12, the steroid group reached 100.00 meters, compared to 97.40 meters in the dextrose group. Damor found steroids significantly improved walking distance and functional outcomes,[18] and Varma et al. reported corticosteroid cocktails enhanced walking ability more rapidly than dextrose[17] (**Table 4**). Raissi et al. noted that while steroids provided quicker functional improvements, dextrose caught up by 12 weeks.[14] Steroids may be preferable for patients needing rapid recovery, though dextrose ultimately offers comparable benefits.

AFAS scores assessed foot and ankle functionality. At the start of study, the dextrose group had a mean AFAS score of 57.16 and the steroid group 58.24. By week 2, the steroid group showed more rapid improvement (77.00 vs. 70.00; $p < 0.001$). By week 12, the steroid group reached 90.00, while the dextrose group peaked at 89.44, showing both treatments were effective but steroids provided faster recovery (**Table 5**). Raissi et al. and Jain et al. also found significant early improvements with corticosteroids, though differences diminished by 12 weeks.[14,21] These results suggest steroids are better for rapid functional recovery, while dextrose offers comparable long-term benefits.

Plantar fascia thickness was evaluated as a structural outcome. At the start of study, the dextrose group had a mean thickness of 6.948 mm, while the steroid group had 6.612 mm. By week 12, both groups showed significant reductions (dextrose: 2.492 mm; steroid: 2.356 mm), with no statistically significant difference between them ($p = 0.354$) (**Table 6**). Ryan et al. found dextrose injections effectively reduced plantar fascia thickness,[20] while Raissi et al. reported slightly greater reductions with corticosteroids, though differences were not clinically significant.[14]

6. Conclusion

This study demonstrates that steroid (triamcinolone acetonide 40 mg) injections are more effective than 25% dextrose injections (2mL) in providing rapid pain relief, improving functional outcomes, and enhancing physical mobility in patients with plantar fasciitis. While both treatments led to significant reductions in plantar fascia thickness, the difference between them was not statistically significant. The findings suggest that corticosteroid injections should be considered a first-line treatment for patients requiring immediate symptom relief, although the potential risks of repeated steroid use must be considered. Dextrose injections, while slower to provide relief, offer a viable alternative, especially for patients concerned about the side effects associated with steroids. Future research should focus on long-term outcomes and the integration of these treatments with other therapeutic modalities to optimize care for plantar fasciitis.

7. Source of Funding

None.

8. Conflict of Interest

None.

9. Ethical Approval

Ethical No.: BJGMC/IEC/Pharmac/D-0323069-069.

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