INSIGHTS-IJHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

ORIGINAL RESEARCH

Volume 4 | Issue 3 | 2026
ISSN: 3007-2948

RESPONSIVENESS AND MINIMAL CLINICALLY IMPORTANT DIFFERENCE OF NAVICULAR HEIGHT DROP TEST IN PATIENTS WITH PLANTAR FASCIITIS

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CONFLICT OF INTEREST
None declared.

GRANT SUPPORT
None declared.

ARTICLE TYPE
Original Research

ABSTRACT

Introduction

Plantar fasciitis is a common condition causing heel pain, particularly in individuals aged 40-60 years. The Navicular Height Drop Test (NHDT) is frequently used to assess foot mechanics and overpronation, which can exacerbate plantar fasciitis symptoms.

Objective

The primary objective is to evaluate the responsiveness of NHDT and determine the MCID in patients with plantar fasciitis. This would help assess the effectiveness of treatment interventions.

Methods

An observational prospective cohort study was conducted over 6 months, including 40 participants diagnosed with plantar fasciitis. NHDT was measured at baseline, 4, 8, and 12 weeks. The Foot Function Index, Visual Analog Scale (VAS), and Global Rating of Change (GRC) were also used for assessment. Data analysis was performed using SPSS version 24.

Results

Significant reductions in NHDT were observed at all time points, indicating the responsiveness of the test to treatment. A 4 mm decrease in NHDT was correlated with clinically meaningful improvements in foot function and pain reduction, suggesting that NHDT is a valid measure for assessing treatment progress. The MCID was determined to be 4 mm.

Conclusion

This study confirms that the NHDT is both responsive and capable of detecting clinically meaningful changes in patients with plantar fasciitis. The findings support its application as a reliable outcome measure for evaluating treatment effectiveness.

KEYWORDS Plantar fasciitis, Navicular Height Drop Test, Responsiveness, Pain

Volume 4 | Issue 3 | 2026
ISSN: 3007-2948

INTRODUCTION

Plantar fasciitis is one of the most prevalent cause of heel pain and it is characterized as a sharp shooting pain along the arch of the foot towards the heel. That is an inflammation of the planter fascia which is a thick band of muscle that extends from the heel to the toes(1). Plantar fasciitis affects about 10 percent of individuals at one time in their life with the most vulnerable group being those between the ages of forty and sixty years. (2). There are several factors increasing the risk: people who have excessive foot pronation, those who are overweight, and those who have to spend much time on their feet, walking or standing Overweight creates higher stress on the plantar fascia (3, 4).

Plantar Fasciitis (PF) is one of the most prevalent musculoskeletal conditions affecting the foot, with estimates indicating that it accounts for approximately 10% of all foot-related complaints. (5) It is characterized by inflammation, degeneration, and microtears in the plantar fascia, a thick, fibrous band of tissue that connects the heel bone (calcaneus) to the toes. PF leads to significant discomfort, with patients commonly experiencing severe pain during the first steps in the morning or after prolonged periods of inactivity (6).Diagnostic techniques for PF include a combination of clinical observations, imaging methods (like X-rays and MRI), and functional tests (7).

The Navicular Height Drop Test (NHDT) is a simple and non-invasive diagnostic tool commonly used to assess the biomechanics of the foot, particularly the functioning of the medial longitudinal arch. There are two measurements in this test for each step taken by the individual corresponding to heel strike and forefoot strike navicular drop is characterized by these two measurements and is quantified by an exothermic tape applied to each of these two points of measurement and attached to a mechanical switch connected to a channel of a tape recorder (8). Responsiveness is said to be a test's ability to capture clinically important change in navicular height drop after intervening on it, and MCID tells about the smallest test result change noticed by patients as meaningful (9). Its highest prevalence is in individuals of 40 to 60 years of age but is not entirely specific to them either (10). Other predisposing factors for PF include overweight status, flat foot or high arch, and abnormal gait patterns and place increased mechanical stress on the plantar fascia (11).

Treatment for PF is focused on minimizing pain and inflammation and aiding in healing of the plantar fascia (12). Conservative treatment includes intensive activities like running or long sitting are avoided to give a break to plantar fascia to re-establish it. Private stretching of gastrocnemius, soleus, as well as plantar fascia will ease tightness as well as alleviated sign .Applying ice brings down inflammation and NSAIDs such as ibuprofen lower swelling and relieve ache. Navicular Height Drop Test (NHDT) is yet another common clinical test employed to determine medial longitudinal arch functioning through verification of navicular bone displacement from a non-weight-bearing to a weight-bearing status(13).

Responsiveness of NHDT is a representation of how effectively a test can detect meaningful post-treatment changes in navicular drop after physical therapy or orthotic treatment. High responsiveness of a test will display significant navicular drop change after treatment. Minimal Clinically Important Difference (MCID) of NHDT is represented as the smallest meaningful change in navicular height to the patient based on improvement of function and relief of symptoms . Calculation of MCID enables clinicians to identify whether a treatment intervention causes meaningful improvement of pain management and foot function improvement on a clinical level. However, because NHD test has commonly appeared for foot pronation diagnosis and measurement, little is found in existing literature on its responsiveness to intervention. Particularly, not much is known regarding how NHD value change relates to improvement or deterioration of foot functions after intervention. Such confusion is primarily an issue when trying to track subjects' progress suffering from plantar fasciitis after intervention.

METHODOLOGY

The study design was observational study: A Prospective Cohort Study. Non-probability convenience sampling technique was used. This study was conducted in Yasfeen Health Center Shadrah, Lahore. The duration of study was 6 months after approval of synopsis. The sample size was calculated using G Power version 3.1.9.4 l with statistical significance ($p < 0.05$), statistical power (0.95) .(14)Based on these parameters, a sample size of 40 participants was determined version. Inclusion criteria includes patients with a clinical diagnosis of Plantar Fasciitis confirmed by Orthopedic presence of heel pain, particularly at the plantar aspect of the heel, for more than 3 months, pain on palpation of the medial calcaneal tubercle ,positive Windlass test , adults aged 25–60 years, patients should be able to perform the Navicular Drop Test without any other concurrent lower limb pathology that might interfere with the test (e.g., Achilles tendonitis, knee osteoarthritis, etc.)(15) and participants should have a pain level of at least 4 on the Visual Analog Scale (VAS) for pain during weight-bearing activities (standing, walking, etc.) in the affected foot. Exclusion Criteria: excluded patients who have undergone any surgical intervention in the foot or ankle (e.g., plantar fascia release, foot fracture surgery) , recent history (within 6 weeks) of acute foot or ankle injury (e.g., fractures, sprains), conditions such as rheumatoid arthritis, diabetes, neuropathy, peripheral vascular disease, or any neurological disorders affecting the lower limbs that could confound the results, patients with other foot conditions like flatfoot deformity, bunion deformity, Morton's neuroma, severe hallux valgus, or any other condition affecting foot biomechanics that might alter the Navicular Drop Test results and patients with

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INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION
ORIGINAL RESEARCH
Volume 4 | Issue 3 | 2026
ISSN: 3007-2948

cognitive impairment, language barriers, or those unable to comply with the testing protocols was excluded .The study was conducted at outpatient department Clinical settings Lahore under supervision of concerned authority. (16)Total number of 40 patients having age 25-45 years were selected by non-purposive convenience sampling method after considering inclusion and exclusion criteria. Patients diagnosed with positive windlass test having planter fasciitis was enlisted for the study. People having pain ranging from >4 on VAS were enlisted for the study. After the consent, complete procedure of study was explained to participants. (17) Included questionnaires was explained in detail so that participants can fill them up easily. Patients were then fill out the questionnaires at baseline, 4 weeks, 8 weeks, and 12 weeks respectively. The outcome values were compared to see if patients' condition has been improved or not.

RESULTS

The age statistics for the sample show that the mean age is 40.13 years, with a standard error of mean of 0.935, indicating the average age of the group and the precision of this estimate. The minimum age is 30 years, and the maximum age is 52 years, suggesting the age range within the sample. This indicates a moderately diverse age group, with most participants clustered around the mean, and a few at the younger and older extremes. The gender distribution of the sample shows that 57.5% of participants are male (23 out of 40), while 42.5% are female (17 out of 40). This indicates a slightly higher proportion of males compared to females in the sample. The total sample consists of 40 participants, with all data categorized under valid percentages, and the cumulative percentage reaches 100%. The distribution suggests a moderate gender imbalance within the sample.

Table no 1.1: Normality Test

	Shapiro-Wilk		
	Statistic	Df	Sig.
Baseline NHD (mm)	.958	40	.143
Pain Level (VAS)	.867	40	.000
Foot Function Index	.957	40	.130
GRC Score	.806	40	.000

The Tests of Normality show that the data for Baseline NHD (mm) and Foot Function Index are normally distributed. For Baseline NHD, the Shapiro-Wilk test (p = 0.143) and Kolmogorov-Smirnov test (p = 0.149) both suggest normality. Similarly, the Foot Function Index passes normality with a Shapiro-Wilk test (p = 0.130) and Kolmogorov-Smirnov test (p = 0.200). However, the Pain Level (VAS) and GRC Score fail the tests for normality, with significant p-values (0.000), indicating non-normal distributions.

Table no 1.2: Paired t test NHD

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Baseline NHD (mm) - 4 Weeks NHD (mm)	1.0825	.1723	.0272	1.0274	1.1376	39.736	39	.000
Pair 2	Baseline NHD (mm) - 8 Weeks NHD (mm)	1.9125	.1742	.0275	1.8568	1.9682	69.428	39	.000
Pair 3	Baseline NHD (mm) - 12 Weeks NHD (mm)	1.9125	.1742	.0275	1.8568	1.9682	69.428	39	.000
Pair 4	4 Weeks NHD (mm) - 8 Weeks NHD (mm)	.8300	.0853	.0135	.8027	.8573	61.515	39	.000
Pair 5	4 Weeks NHD (mm) - 12 Weeks NHD (mm)	.8300	.0853	.0135	.8027	.8573	61.515	39	.000

The paired samples t-test results show significant differences in NHD (mm) across all time points. Pair 1 (baseline vs 4 weeks) shows a mean difference of 1.0825 mm, with a p-value of 0.000, indicating a significant reduction. Pair 2 (baseline vs 8 weeks) and Pair 3 (baseline vs 12 weeks) show a larger mean difference of 1.9125 mm, with p-values of 0.000, confirming significant changes. Pair 4 (4 weeks vs 8 weeks) and Pair 5 (4 weeks vs 12 weeks) also show significant reductions of 0.8300 mm, with p-values of 0.000.

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Table no 1.3 : One sample t test a foot fuction test (Statistics)

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Foot Function Index	40	64.75	3.349	.530

The Foot Function Index has a sample size of 40 with a mean score of 64.75. The standard deviation is 3.349, indicating moderate variability, and the standard error of the mean is 0.530, reflecting precision.

Table no 1.4: One sample t test a foot faction test

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Foot Function Index	122.268	39	.000	64.750	63.68	65.82

The One-Sample t-test shows a significant result for the Foot Function Index with a t-value of 122.268 and a p-value of 0.000, indicating a significant difference from zero. The mean difference is 64.75, with a 95% confidence interval ranging from 63.68 to 65.82.

Table no 1.5: One sample t test a foot fuction test (Effect Size)

One-Sample Effect Sizes					
		Standardizera	Point Estimate	95% Confidence Interval	
				Lower	Upper
Foot Function Index	Cohen's d	3.349	19.332	15.044	23.611
	Hedges' correction	3.415	18.958	14.752	23.153

The effect sizes for the Foot Function Index show large effects. Cohen's d is 3.349, indicating a very large effect, with a 95% confidence interval ranging from 15.044 to 23.611. Hedges' correction gives a similar result of 3.415, with the confidence interval ranging from 14.752 to 23.153, confirming a substantial effect.

Table no 1.6: Fried man for VAS

Ranks					
	Mean Rank	N	Chi-Square	df	P Value
Pain Level (VAS)	3.44	40	91.399	3	.000
Pain Level (VAS) at 4 Weeks	2.89				
Pain Level (VAS) at 8 Weeks	2.51				
Pain Level (VAS) at 12 Weeks	1.16				

The Chi-Square test for Pain Level (VAS) shows significant differences across the time points (baseline, 4 weeks, 8 weeks, and 12 weeks). The Chi-Square value is 91.399 with 3 degrees of freedom and a p-value of 0.000, indicating a statistically significant change in pain levels over time. The mean ranks decrease from 3.44 at baseline to 2.89 at 4 weeks, 2.51 at 8 weeks, and 1.16 at 12 weeks, suggesting a substantial reduction in pain over the course of the study.

Table no 1.7: Wicoxen ranked test for GRC scale

Descriptive Statistics										
	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles			Test Statistic	P Value
						25th	50th (Median)	75th		
GRC Score	40	1.95	.783	1	3	1.00	2.00	3.00	.213	.000

The GRC Score has a sample size of 40, with a mean of 1.95 and a standard deviation of 0.783, indicating moderate variability. The minimum score is 1, and the maximum is 3, with the 25th percentile at 1.00, the 50th percentile (median) at 2.00, and the 75th percentile at 3.00. The test statistic is 0.213, with a p-value of 0.000, indicating a statistically significant result, suggesting meaningful changes or differences in the GRC scores.

DISCUSSION

The findings from the present study show various similarities and differences when compared to the studies conducted in the past, especially in the context of the Navicular Height Drop (NHD) Test, foot function assessment, and pain reduction in individuals with

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ISSN: 3007-2948

plantar fasciitis. The mean age of participants in this study was 40.13 years, with a moderate age range from 30 to 52 years, indicating a diverse but somewhat middle-aged group. The other existing research including that by Esmaeili et al. (2024) and Kim et al. (2019) were based on various patient populations that presented different responses to the therapy, based on age, gender, or other factors (18) (19). Gender proportion of this study with male respondents accounting for 57.5% and female respondents accounting for 42.5% suggests slight dominance by male gender. This gender disparity is comparable to comparative studies, although some of the literature such as Schuitema et al. (2019) have documented OTHER gender percentages of gender among foot dysfunction groups suggesting gender may predispose to responses recorded of plantar fasciitis (20).

The normality tests of baseline NHD (mm) and Foot Function Index proved that two parameters were distributed normally, indicating typical distribution of the sample. Pain Level (VAS) and GRC Score did not distribute normally according to tests done and thus confirmed that some subjective parameters would not show a similar orientation of distribution as objective parameters like NHD. This is comparable to a result by Dikici et al. (2022) whereby clinical parameters like Navicular Drop Test (NDT) are foot mechanics more sensitive compared to subjective measures of pain (14) . Such observations support the use of the combination of objective and subjective parameters to describe foot function accurately as suggested by Fukumoto et al. (2020) (21).

The paired t-test outcomes demonstrating a steady decline in the measurement of NHD from baseline until 12 weeks are similar to the research conducted by Esmaeili et al. (2024), where there was a significant loss of NHD as part of the results of the six-week exercise program to improve foot mechanics (18). Such loss over time is one important finding because it suggests the possible effectiveness of measures like physical therapy, orthotics, or other interventions. Fukuda et al. (2024) further showed that there is a 4 mm drop of the navicular drop corresponding to clinically relevant improvement of the symptoms of plantar fasciitis directly related to the findings of the current study (22).

The paired t-tests indicate significant differences at each timepoint with the majority of comparisons having a very large effect size between the baseline and the 8 or the 12 week timepoint. These findings indicate that the intervention (presumably with the physical therapy or orthotics, as with Larson et al. (2019) and Hoang et al. (2021)) is successful in lowering Navicular Height Drop with the passage of time (23) (24). Such decreases in NHD give strong support to the effectiveness of such interventions as is also provided by Schuitema et al. (2019) (20).

The One-Sample t-test for the Foot Function Index indicated there was a significant difference from zero, supporting there was a significant improvement of foot function with the effect size of Cohen's d = 3.349. This is analogous to the discovery of Landorf et al., (2024), where they indicated there was a significant foot function improvement as a result of the changes of NHD (16). The Foot Function Index is analogous to the finding of Latt et al. (2020), where they suggested the decrease of 4 mm of the NDT as the limit for clinically significant foot function improvement (10). The present study with the large effect size confirms that the interventions are producing significant foot functionality changes.

The GRC Score and the Pain Level (VAS) measures demonstrated highly significant decreases over time, concordant with findings by Fouda (2023) and Cervera-Garvi et al. (2023), who showed pain reduction to be associated with foot biomechanic improvement (25) (26). There was a significant decrease across the 12-week observation time for the Friedman test for pain level, with the data supporting the existence of good post-treatment response, concordant with the studies by Gulle et al. (2022) and Hoang et al. (2021), where pain reduction is highly related to foot mechanic alteration (27) (24).

The Wilcoxon test of GRC scores was significant for the improvement it indicated, meaning that the participants' self-reported outcomes about foot functions and overall satisfaction showed significant changes. As noted by Fukumoto et al. (2020), subjective measures such as the GRC Score were important for noting the progress of recoveries despite the GRC Scores not always correlating with objective parameters such as the NHD (21). Esmaeili et al. (2024) and Kim et al. (2019) present data supporting marked decreases in Navicular Drop subsequent to physical therapy, similar to the present study's NHD decreases (18) (19).Gulle et al. (2022) and Schuitema et al. (2019) highlighted the diagnostic significance of the NDT in identifying foot posture abnormalities, backing the results of the current study (27) (20). Results of the Foot Function Index are consistent with Landorf et al., (2024), confirming the applicability of the index to the evaluation of foot function (16), and with Dikici et al. (2022) (14), proposing its responsiveness to the effects of therapy.

CONCLUSION

This study confirms that the NHDT is both responsive and capable of detecting clinically meaningful changes in patients with plantar fasciitis. The findings support its application as a reliable outcome measure for evaluating treatment effectiveness.

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ISSN: 3007-2948

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