RESEARCH PAPER

COMPARISON OF TWO DIFFERENT STRETCHING DURATION OF PLANTARFASCIA AND ACHILLES TENDON ON PAIN AND FUNCTION IN PLANTAR FSCIITIS

Sanaullah Ansari[1]", Dr. Huma Zahoor Ahmed Siddiqui[2], Dr. Monika Sharma[3]

[1] Department of Physiotherapy, Institute of Applied Medicines and Research (IAMR), Ghaziabad, Uttar Pradesh, India; affiliated to Atal Bihari Vajpayee Medical University, Lucknow, Uttar Pradesh, India.

2 Professor, Department of Physiotherapy, Institute of Applied Medicines and Research (IAMR), Ghaziabad, Uttar Pradesh, India; affiliated to Atal Bihari Vajpayee Medical University, Lucknow, Uttar Pradesh, India.

[3]Professor and Principal, Department of Physiotherapy, Institute of Applied Medicines and Research (IAMR), Ghaziabad, Uttar Pradesh, India — affiliated to Atal Bihari Vajpayee Medical University, UP, Lucknow

Co-author: Dr. Huma Zahoor Ahmed Siddiqui — [siddiquihuma132@gmail.com]

ABSTRACT

Background: Plantar fasciitis is a common musculoskeletal condition characterized by plantar-medial heel pain, particularly during the first steps in the morning and following prolonged periods of inactivity. Stretching of the plantar fascia and Achilles tendon is frequently used as a conservative physiotherapy intervention; however, the optimal stretching duration for achieving maximum clinical benefit remains unclear.

Objective: To compare the effects of two different stretching durations of the plantar fascia and Achilles tendon on pain, functional ability, and ankle dorsiflexion range of motion in individuals with plantar fasciitis.

Materials and Methodology: A randomized controlled trial was conducted among 20 participants aged 20–40 years with plantar fasciitis. Participants were randomly allocated into two equal groups of 10 participants each. Group A received short-duration stretching with a hold time of 10–15 seconds, whereas Group B received long-duration stretching with a 30-second hold. Both groups performed standardized plantar fascia, gastrocnemius, and soleus stretching exercises for six weeks. The primary outcome measures were the Numeric Pain Rating Scale (NPRS), Foot Function Index (FFI), and ankle dorsiflexion Range of Motion (ROM).

Results: Both groups demonstrated significant improvement in pain, functional ability, and ankle dorsiflexion ROM following intervention. Group A showed mean improvements of 3.4 points in NPRS,
28.6 points in FFI, and 5.2° in ROM, while Group B demonstrated greater mean improvements of 5.8 points, 47.3 points, and 10.4°, respectively. The between-group differences were statistically significant ($p < 0.05$), indicating greater clinical improvement with long-duration stretching.

Conclusion: Both short- and long-duration stretching of the plantar fascia and Achilles tendon were effective in reducing pain, improving foot function, and increasing ankle dorsiflexion ROM in individuals with plantar fasciitis. However, 30-second long-duration stretching produced superior improvements compared with 10–15-second short-duration stretching. Therefore, longer stretching duration may be considered more beneficial in the conservative physiotherapy management of plantar fasciitis.

Keywords: Plantar Fasciitis, Plantar Fascia, Achilles Tendon, Stretching Duration, NPRS, Foot Function Index, Range of Motion.

How to cite this article: Sanaullah Ansari1" Dr. Huma Zahoor Ahmed Siddiqui2 Dr. Monika Sharma3. COMPARISON OF TWO DIFFERENT STRETCHING DURATION OF PLANTARFASCIA AND ACHILLES TENDON ON PAIN AND FUNCTION IN PLANTAR FSCIITIS. Int J Drug Deliv Technol. 2026;16(89s):579-586. DOI: 10.25258/ijddt.16.89s.60.

INTRODUCTION

Plantar fasciitis (PF) is one of the most common musculoskeletal disorders affecting the foot and is considered a major cause of plantar heel pain in adults. It is generally characterized by pain and tenderness over the plantar-medial aspect of the heel, particularly near the medial calcaneal tubercle. Patients commonly report severe pain during the first few steps after waking in the morning or following a prolonged period of inactivity. Symptoms may also become aggravated during prolonged standing, walking, running, or other weight-bearing activities. Because these activities are integral to daily living, persistent plantar heel pain may considerably restrict mobility, occupational activities, recreational participation, and overall functional performance.[1,16,20]

The plantar fascia is a dense fibrous connective tissue structure extending from the medial tubercle of the calcaneus toward the plantar aspect of the metatarsophalangeal joints. It plays an important role in maintaining the medial longitudinal arch of the foot and contributes to the mechanical stability of the foot during weight-bearing activities.[15,16] During standing and locomotion, the plantar fascia functions as a tension-bearing structure and assists in distributing forces across the foot. Through the windlass mechanism, dorsiflexion of the toes increases tension within the plantar fascia, contributing to elevation and stabilization of the medial longitudinal arch during the later phases of

gait.[15]

Although the term plantar fasciitis traditionally implies an inflammatory process, histopathological evidence indicates that chronic plantar fasciitis may primarily represent a degenerative process rather than persistent inflammation. Repetitive mechanical loading and microtrauma at the calcaneal attachment of the plantar fascia may result in collagen disorganization, microtears and degenerative tissue changes, a process sometimes described as plantar fasciosis.[17] Consequently, repetitive tensile stress, inadequate tissue recovery and altered foot biomechanics are considered important contributors to the development and persistence of plantar heel pain.

Plantar fasciitis may develop due to a combination of intrinsic and extrinsic risk factors. Intrinsic factors include reduced ankle dorsiflexion, tightness of the gastrocnemius–soleus complex, increased body weight, altered foot posture and abnormalities in foot biomechanics. Extrinsic factors include prolonged standing, repetitive weight-bearing activities, sudden increases in physical activity, inappropriate footwear and excessive training loads.[18,19] Restricted ankle dorsiflexion is
particularly important because limited flexibility of the gastrocnemius–soleus complex may alter lower-limb mechanics and increase mechanical stress transmitted to the plantar fascia during walking and other functional activities.[18]

The Achilles tendon and plantar fascia are anatomically and biomechanically related structures. The Achilles tendon acts as an important force-transmitting structure between the triceps surae muscle complex and the calcaneus, while the plantar fascia contributes substantially to the maintenance of the longitudinal arch of the foot.[11,13] Anatomical investigations have demonstrated a structural relationship between the Achilles tendon and plantar fascia through the posterior calcaneal region, supporting the concept that changes in tension within one structure may influence mechanical loading of the other.[13]

Biomechanical evidence further suggests that increased Achilles tendon loading can result in increased strain and tension within the plantar fascia. Carlson et al. demonstrated a biomechanical relationship between Achilles tendon tension and plantar fascia strain, indicating that increased tension within the Achilles tendon can influence plantar fascia mechanics.[11] Similarly, Cheung et al. reported that Achilles tendon loading affects tension within the plantar fascia, further demonstrating the mechanical interaction between these structures.[12] Therefore, excessive tightness of the gastrocnemius–soleus complex and Achilles tendon may contribute to increased tensile loading of the plantar fascia.

The Achilles tendon is also essential for efficient transmission of muscular forces during gait and other weight-bearing activities. Its mechanical properties, including stiffness and elasticity, influence the efficiency with which forces generated by the triceps surae are transferred to the foot and ankle.[14] In contrast, the plantar fascia acts as an important stabilizer of the medial longitudinal arch and is repeatedly subjected to tensile stress during standing, walking, running and jumping.[15] Disturbances in the mechanical relationship between these structures may therefore contribute to abnormal loading patterns and the persistence of plantar heel symptoms. These biomechanical relationships are also discussed in the existing thesis Introduction.

The diagnosis of plantar fasciitis is primarily clinical and is based on the characteristic history and physical examination findings. Patients generally present with plantar-medial heel pain that is most severe during the first steps in the morning and may recur after periods of rest. Localized tenderness over the medial calcaneal tubercle is commonly present, and symptoms may be reproduced by stretching the plantar fascia. Imaging investigations are not routinely required but may be useful in chronic or atypical cases or when alternative causes of heel pain need to be excluded.[20-22]

Conservative management is considered the primary approach for most individuals with plantar fasciitis. Treatment strategies may include activity modification, appropriate footwear, orthotic devices, taping, manual therapy, cryotherapy, stretching exercises and strengthening programmes.[20-22] Among these interventions, stretching is particularly attractive because it is
inexpensive, non-invasive, relatively simple to perform and can readily be incorporated into both supervised physiotherapy and home exercise programmes.

Stretching of the plantar fascia and gastrocnemius–soleus/Achilles tendon complex is widely incorporated into rehabilitation programmes for plantar fasciitis. The therapeutic rationale is to improve flexibility of the involved soft tissues, reduce excessive tensile loading on the plantar fascia and improve ankle dorsiflexion. By decreasing tightness within the calf musculature and Achilles tendon, stretching may reduce mechanical stress transmitted to the plantar fascia during weight-bearing activities. Plantar fascia-specific stretching may additionally provide a more direct mechanical effect on the affected tissue.[1,2]

DiGiovanni et al. investigated tissue-specific plantar fascia stretching in patients with chronic heel pain and demonstrated beneficial effects on pain and functional outcomes.[1] Their findings provided important evidence supporting plantar fascia-specific stretching as a conservative treatment strategy. Similarly, Radford et al. evaluated calf muscle

stretching for plantar heel pain and reported improvement in short-term symptoms, supporting the therapeutic role of stretching in plantar heel pain management.[2]

The effectiveness of stretching, however, may depend on several exercise prescription variables. These include the type of stretching technique, intensity, frequency, number of repetitions and the duration for which each stretch is maintained. The existing literature contains considerable variation in stretching protocols, making it difficult to establish a universally accepted stretching dosage.[5] Sweeting et al., in their systematic review, identified substantial heterogeneity among stretching interventions used for plantar heel pain and highlighted the need for greater standardization of stretching protocols.[5]

Stretch duration is particularly important because the amount of time that a musculotendinous structure remains under tension may influence tissue extensibility and subsequent changes in range of motion. Short-duration stretching may be easier to perform, less time-consuming and potentially associated with better adherence to home programmes. Conversely, a longer sustained stretch may provide a more prolonged mechanical stimulus and potentially produce greater improvements in soft-tissue flexibility and ankle dorsiflexion. Therefore, identifying an appropriate stretching duration is clinically relevant when designing efficient rehabilitation protocols.

Porter et al. investigated the effects of the duration and frequency of Achilles tendon stretching on ankle dorsiflexion and clinical outcomes in painful heel syndrome.[8] Their work demonstrated the clinical relevance of manipulating stretching parameters and supported further investigation into stretching dosage. Evidence included in the thesis also describes comparisons between
sustained and intermittent Achilles tendon stretching protocols, indicating continued uncertainty regarding the most appropriate stretching duration.

Combined stretching of the plantar fascia and Achilles tendon may be particularly relevant because plantar fasciitis is influenced by the mechanical interaction between the plantar fascia, Achilles tendon and gastrocnemius–soleus complex. Engkananuwat et al. investigated Achilles tendon and plantar fascia stretching in individuals with plantar fasciitis and demonstrated beneficial changes in clinical outcomes.[7] Similarly, other studies comparing plantar fascia-specific and Achilles tendon stretching have provided support for stretching as an important component of conservative rehabilitation.[1,9,10]

Although evidence supports stretching for plantar fasciitis, there remains uncertainty regarding the optimum duration for which an individual stretch should be maintained. Many previous investigations have compared different types of interventions or plantar fascia-specific stretching with Achilles tendon stretching, whereas fewer studies have specifically examined stretching hold duration as the primary intervention variable. The thesis itself identifies this lack of clarity regarding stretching duration as an important research gap.

Pain and functional limitation are among the major clinical consequences of plantar fasciitis and are therefore important outcomes when determining treatment effectiveness. The Numeric Pain Rating Scale (NPRS) can be used to quantify perceived pain intensity, while the Foot Function Index (FFI) provides information regarding pain, disability and activity-related functional limitations. Ankle dorsiflexion range of motion provides an additional objective clinical measure related to flexibility of the gastrocnemius–soleus/Achilles tendon complex. In the present thesis, these outcomes are used to evaluate changes associated with different stretching durations.

The present study therefore compares two different stretching durations for the plantar fascia and Achilles tendon in individuals with plantar fasciitis. Participants receive the same fundamental stretching programme, with stretching hold duration serving as the primary difference between the intervention groups. By standardizing other components of the exercise programme, the study aims to determine whether variation in stretching duration influences pain reduction, functional improvement and ankle dorsiflexion range of motion.

Materials and Methodology

The present study was conducted as a randomized controlled trial with two parallel intervention groups to compare the effectiveness of two different stretching durations of the plantar fascia and Achilles tendon on pain, functional ability, and ankle dorsiflexion range of motion in individuals with plantar fasciitis. A total of 20 participants clinically diagnosed with plantar
fasciitis and aged between 20 and 40 years were included in the study. Participants were recruited from the Physiotherapy Outpatient Department and were screened according to predefined eligibility criteria. The study intervention was carried out over a period of six weeks. The thesis describes baseline assessment before intervention, an intermediate assessment at the end of the third week, and final assessment after completion of six weeks of treatment.

Participants were considered eligible if they had a clinical diagnosis of plantar fasciitis, heel pain persisting for more than four weeks, characteristic first-step pain in the morning, localized tenderness over the medial calcaneal tubercle, and a Numeric Pain Rating Scale (NPRS) score of at least 4/10. Participants were required to be willing to participate and provide written informed consent. Individuals

with a previous history of foot or heel surgery, corticosteroid injection within the preceding three months, neurological disorders, systemic inflammatory diseases such as rheumatoid arthritis, previous foot or heel fracture, pregnancy, neuropathy, or the presence of red-flag symptoms were excluded from participation.

Prior to commencement of the intervention, the purpose, procedure, and potential benefits of the study were explained to the participants and written informed consent was obtained. Baseline demographic and clinical information, including age, gender, occupation, duration of symptoms, footwear habits, and activity level, was documented. Pain intensity was assessed using the Numeric Pain Rating Scale, functional status was evaluated using the Foot Function Index, and ankle dorsiflexion range of motion was measured using a universal goniometer. The thesis also mentions the Foot and Ankle Ability Measure as an additional functional measure; however, the principal outcomes consistently reported for the study are NPRS, FFI, and ankle dorsiflexion ROM.

Following baseline evaluation, the participants were randomly allocated into two equal groups, with 10 participants in each group. Randomization was described as computer-generated with sealed-envelope allocation concealment, and the assessor recording the outcome measurements was intended to remain blinded to group allocation to minimize measurement bias. Group A was designated as the short-duration stretching group, whereas Group B was designated as the long-duration stretching group. Except for the duration of the stretching hold, both groups followed the same stretching exercises, repetitions, sets, and overall intervention period.

Participants in Group A performed short-duration stretching of the plantar fascia and Achilles tendon, with each stretch maintained for approximately 10–15 seconds followed by a rest interval of 10–15 seconds. Participants in Group B performed the same stretching exercises, but each stretch was maintained for approximately 30 seconds followed by a rest interval of 15–20 seconds. In both groups, the exercises were performed for three sets of five repetitions. According to the intervention protocol, stretching was performed twice daily for five days per week and was continued for six weeks. The stretching intensity was maintained at a mild-to-moderate level without producing sharp or excessive pain.

The intervention consisted of plantar fascia stretching along with gastrocnemius and soleus stretching to address the Achilles tendon–calf muscle complex. For plantar fascia stretching, the participant was positioned in long sitting or sitting with the affected leg comfortably supported. A towel or belt was placed around the forefoot and toes, and the participant gently pulled the toes and ankle into dorsiflexion until a stretching sensation was perceived along the medial longitudinal arch and heel region. Particular emphasis was placed on controlled dorsiflexion and extension of the great toe. The stretch was maintained according to the participant's allocated group, namely 10–15 seconds for Group A and 30 seconds for Group B, after which the participant relaxed before the next repetition. Jerky or bouncing movements were avoided, and stretching was not permitted to produce severe pain.

Achilles tendon stretching included separate gastrocnemius and soleus stretching exercises using the wall-stretch technique. For the gastrocnemius stretch, the participant stood facing a wall in a staggered stance with the affected leg positioned behind the unaffected leg. The back knee was maintained in extension and the heel remained in contact with the floor while the participant leaned forward toward the wall until a comfortable stretch was experienced in the posterior calf. For the soleus stretch, a similar position was maintained; however, the knee of the affected leg was slightly flexed while the heel remained firmly on the ground, thereby emphasizing stretching of the soleus muscle and the lower portion of the Achilles tendon. Both stretches were maintained for 10–15 seconds in Group A and 30 seconds in Group B. Each gastrocnemius and soleus stretch was performed for five repetitions and three sets per session.

To facilitate correct performance and adherence, participants attended supervised physiotherapy sessions three times per week for monitoring and correction of stretching technique. They were additionally instructed to continue the prescribed home exercise programme and maintain an exercise diary for monitoring compliance. Both groups received standardized advice regarding modification of activities that aggravated heel pain, avoidance of prolonged standing and barefoot walking on hard surfaces, and the use of comfortable, cushioned, and supportive footwear. Cryotherapy for approximately 10–15 minutes could be advised if symptoms increased after daily activities.

Pain intensity was evaluated using the Numeric Pain Rating Scale, on which participants rated their pain from 0, representing no pain, to 10, representing the worst imaginable pain. Pain was particularly considered during the first steps in the morning, prolonged walking or standing, and following daily activities. Functional disability was assessed using the Foot Function Index, which evaluates the influence of foot pain on activities such as walking, standing, stair climbing, and other daily functional tasks, with higher scores representing greater pain and disability. Ankle

dorsiflexion range of motion was measured in degrees using a universal goniometer with the knee in both

extended and flexed positions to reflect flexibility of the gastrocnemius–soleus complex.

Outcome measurements were recorded at baseline, reassessed after three weeks, and finally evaluated at the completion of the six-week intervention. Pre- and post-intervention values of NPRS, FFI, and ankle dorsiflexion ROM were compared within each group to determine treatment-related improvement and between the two groups to establish the relative effectiveness of short-duration versus long-duration stretching. The study was therefore designed to keep the stretching technique and overall programme similar between groups while primarily varying the stretching hold duration, enabling assessment of whether a longer stretching duration produced greater improvement in pain, functional ability, and ankle mobility.

RESULTS

A total of 20 participants with plantar fasciitis were included in the study and were allocated equally into two intervention groups, with 10 participants in Group A receiving short-duration stretching and 10 participants in Group B receiving long-duration stretching. The clinical outcomes evaluated were pain intensity using the Numeric Pain Rating Scale (NPRS), functional disability using the Foot Function Index (FFI), and ankle dorsiflexion range of motion (ROM). The thesis reports statistically significant pre- to post-intervention improvement in all three outcome measures in both groups, with the level of statistical significance set at $p<0.05$.

Pain intensity decreased substantially following treatment in both groups. In Group A, the mean NPRS score decreased from 8.1 at baseline to 4.7 after intervention, representing a mean improvement of 3.4 points. In Group B, the corresponding mean NPRS score decreased from 8.2 to 2.4, representing a larger mean improvement of 5.8 points. The improvement was reported as statistically significant ($p<0.05$). Thus, although both stretching protocols were effective in reducing pain, a greater reduction in pain intensity was observed in the long-duration stretching group.

A similar pattern was observed for functional disability. The mean FFI score in Group A decreased from 72.4 before treatment to 43.8 after treatment, corresponding to an improvement of 28.6 points. In Group B, the mean FFI score decreased from 73.1 at baseline to 25.8 following intervention, resulting in a considerably larger improvement of 47.3 points. These changes were reported as statistically significant ($p<0.05$). The greater reduction in FFI score observed in Group B indicates greater improvement in foot-related functional ability following long-duration stretching.

Ankle dorsiflexion ROM also improved in both intervention groups. Group A demonstrated an increase in mean dorsiflexion ROM from 10.1° at baseline to 15.3° after intervention, corresponding to an improvement of 5.2°. Group B demonstrated an increase from 10.2° to 20.6°, representing an improvement of 10.4°. The improvement was statistically significant ($p<0.05$), and the magnitude of change was approximately twice as large in Group B as in Group A.

Age Distribution

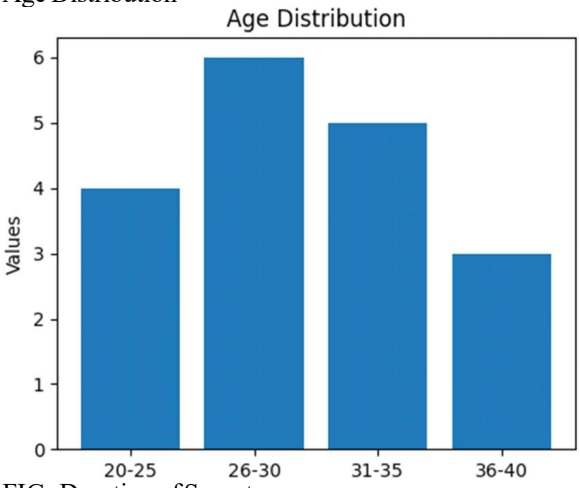


FIG: Duration of Symptoms

FIG: Mean NPRS Improvement

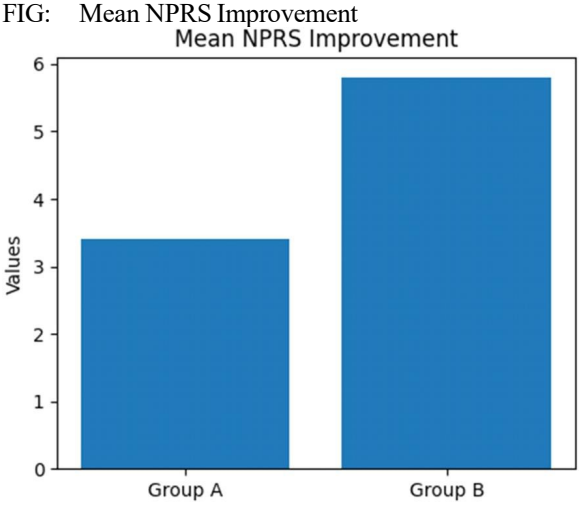


FIG:Mean FFI Improvement

Group A: short-duration stretching; Group B: long-duration stretching; NPRS: Numeric Pain Rating Scale; FFI: Foot Function Index; ROM: Range of Motion. Values are reproduced from the thesis results.

Comparison of the magnitude of improvement showed a consistent advantage for long-duration stretching across all outcome measures. NPRS improvement was 3.4 versus 5.8 points, FFI improvement was 28.6 versus 47.3 points, and ankle dorsiflexion ROM improvement was 5.2° versus 10.4° for Groups A and B, respectively. Overall, the thesis reports that long-duration stretching produced greater improvements in pain reduction, functional ability, and ankle mobility compared with short-duration stretching.

Twenty participants with plantar fasciitis completed the study, with 10 participants allocated to the short-duration stretching group (Group A) and 10 to the long-duration stretching group (Group B). Both groups demonstrated statistically significant improvement in pain, functional disability, and ankle dorsiflexion ROM following the intervention ($p<0.05$). The mean NPRS score decreased from 8.1 to 4.7 in Group A and from 8.2 to 2.4 in Group B, corresponding to mean reductions of 3.4 and 5.8 points, respectively. The mean FFI score decreased from 72.4 to 43.8 in Group A and from 73.1 to 25.8 in Group B, representing improvements of 28.6 and 47.3 points, respectively. Mean ankle dorsiflexion ROM increased from 10.1° to 15.3° in Group A and from 10.2° to 20.6° in Group B, corresponding to gains of 5.2° and 10.4°, respectively. Overall, the magnitude of improvement was greater in Group B across all three outcome measures, indicating better clinical outcomes with long-duration stretching.

DISCUSSION

The present study was conducted to compare the effects of short-duration and long-duration stretching of the plantar fascia and Achilles tendon on pain, functional ability, and ankle dorsiflexion range of motion in individuals with plantar fasciitis. The findings demonstrated significant improvement in all three clinical outcomes in both groups; however, the magnitude of improvement was consistently greater in the long-duration stretching group. The thesis reports that Group B achieved greater reductions in NPRS and FFI scores and a larger increase in ankle dorsiflexion ROM compared with Group A, with statistically significant differences reported at $p<0.05$.

Pain reduction was observed in both groups following the six-week stretching programme. Group A showed a mean reduction in NPRS of 3.4 points, whereas Group B demonstrated a greater reduction of 5.8 points. This suggests that both stretching durations were effective in reducing plantar heel pain, but maintaining the stretch for a longer period produced a larger clinical improvement. The thesis interprets this finding as potentially being related to better elongation and flexibility of the plantar fascia and Achilles tendon with prolonged stretching, thereby reducing mechanical stress around the medial calcaneal region and decreasing tension transmitted through the gastrocnemius–soleus complex.

These findings are consistent with the work of DiGiovanni et al., who reported significant reductions in pain and improvements in functional outcomes following plantar fascia-specific stretching in patients with chronic plantar heel pain. Similarly, Radford et al. demonstrated improvement in morning heel pain following calf stretching. In the present study, both groups improved, but the greater reduction in NPRS observed in the long-duration stretching group suggests that stretching hold time may influence the magnitude of symptomatic improvement. The thesis itself relates the present findings to both DiGiovanni et al. and Radford et al.

Functional disability, as assessed by the Foot Function Index, also improved significantly following intervention. Group A demonstrated a mean improvement of 28.6 points, whereas Group B showed a considerably greater mean improvement of 47.3 points. The greater reduction in FFI score in Group B indicates improved ability to perform weight-bearing and daily activities with less pain and disability. The thesis notes that participants in the long-duration group showed better functional mobility and fewer limitations in walking, standing, and other daily activities.

The greater improvement in functional outcome observed with long-duration stretching may be associated with improvements in tissue flexibility and reduced mechanical loading during weight-bearing activities. As flexibility of the gastrocnemius–soleus complex and Achilles tendon improves, compensatory stress acting on the plantar fascia may decrease, potentially allowing individuals to walk and stand with less discomfort. The thesis discussion similarly attributes improved function to enhanced flexibility of the plantar fascia and Achilles tendon and reduced stress during weight-bearing activities.

The present findings are also discussed in relation to Rathleff et al., whose work suggested that greater tissue loading and prolonged mechanical stimulation may contribute to improved clinical outcomes in plantar fasciitis. Although the intervention investigated by Rathleff et al. was not identical to the present protocol, the thesis uses this study to support the concept that the manner and duration of tissue loading may influence treatment response. Therefore, the larger improvement in FFI observed in Group B may support the clinical relevance of maintaining stretching for a longer duration.

Ankle dorsiflexion ROM improved in both groups, but the increase was greater in Group B. Group A improved by 5.2°, while Group B improved by 10.4°. This finding is clinically relevant because restricted ankle dorsiflexion and tightness of the gastrocnemius–soleus complex are frequently associated with altered foot biomechanics and increased tension on the plantar fascia. Greater improvement in dorsiflexion may therefore help reduce compensatory loading during gait and other weight-bearing activities.

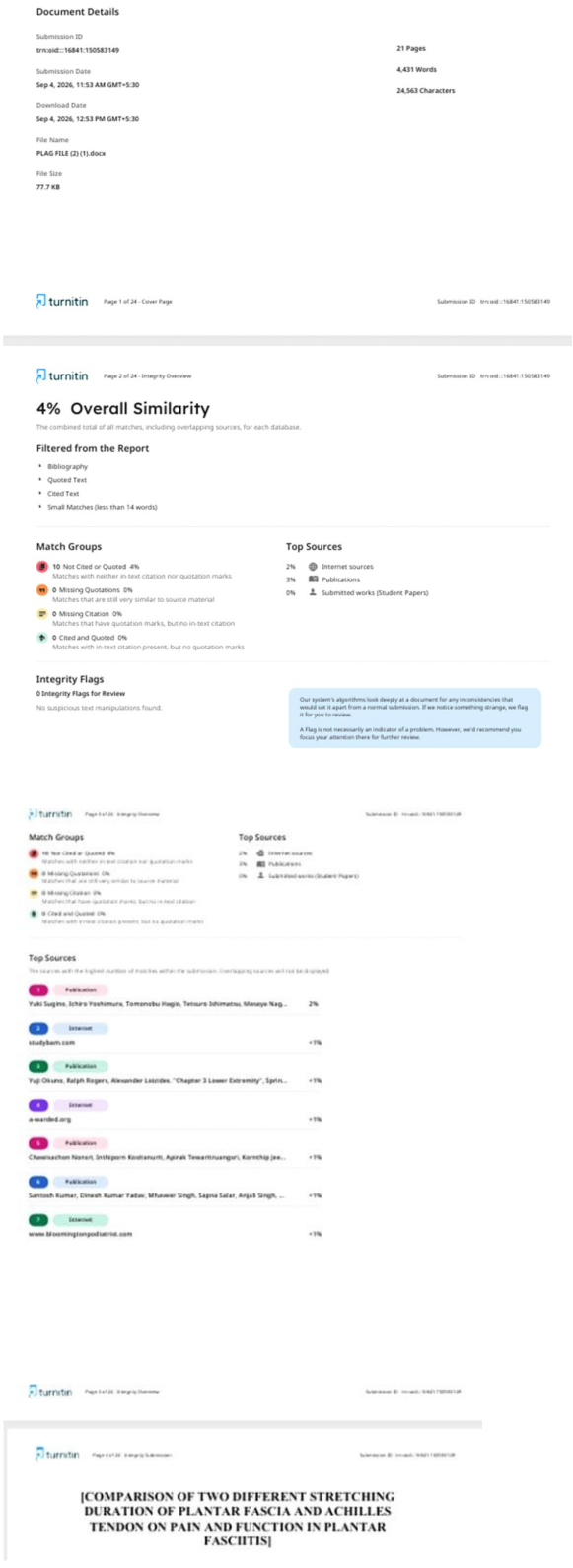
The thesis interprets the greater ROM gain in the long-duration stretching group as a possible consequence of improved muscle extensibility and flexibility produced by prolonged stretching. It also compares the findings with Theriault and Lachance, who reported greater dorsiflexion gains with longer

stretch hold durations, and with Porter et al., who demonstrated improvement following sustained Achilles tendon stretching protocols. These comparisons support the possibility that longer stretch durations may provide a more sustained mechanical stimulus to the musculotendinous unit.

The overall pattern of findings was consistent across pain, functional disability, and ankle mobility. Both interventions were beneficial, which supports the role of stretching as an important conservative physiotherapy strategy for plantar fasciitis. However, Group B demonstrated superior mean improvement across all three outcomes: NPRS improvement was 5.8 compared with 3.4 in Group A, FFI improvement was 47.3 compared with 28.6, and ROM improvement was 10.4° compared with 5.2°. This consistent difference suggests that the duration for which a stretch is maintained may be an important variable in designing stretching programmes for plantar fasciitis.

References

- DiGiovanni BF, Nawoczenski DA, Lintal ME, Moore EA, Murray JC, Wilding GE, et al. Tissue-specific plantar fascia-stretching exercise enhances outcomes in patients with chronic heel pain. J Bone Joint Surg Am. 2003;85(7):1270–7.
- Radford JA, Landorf KB, Buchbinder R, Cook C. Effectiveness of calf muscle stretching for the short-term treatment of plantar heel pain: a randomized trial. BMC Musculoskelet Disord. 2007;8:36.
- Rathleff MS, Mølgaard CM, Fredberg U, Kaalund S, Andersen KB, Jensen TT, et al. High-load strength training improves outcome in patients with plantar fasciitis. Scand J Med Sci Sports. 2015;25(3):e292–300.
- Rompe JD, Furia J, Weil L Jr, Maffulli N. Shock wave therapy versus conventional treatment for chronic plantar fasciopathy. Am J Sports Med. 2010;38(6):1200–7.
- Sweeting D, Parish B, Hooper J, Chester R. The effectiveness of manual stretching in the treatment of plantar heel pain: a systematic review. J Foot Ankle Res. 2011;4:19.
- Theriault KM, Lachance CC. Comparison of Achilles tendon stretching durations on ankle dorsiflexion. Physiother Theory Pract. 2016;32(5):356–62.
- Engkananuwat P, Kanlayanaphotporn R, Purepong N. Effectiveness of Achilles tendon and plantar fascia stretching in plantar fasciitis. J Med Assoc Thai. 2018;101(3):412–8.
- Porter DA, Barrill E, Oneacre K, May BD. The effects of duration and frequency of Achilles tendon stretching on dorsiflexion and outcome in painful heel syndrome. Foot Ankle Int. 2002;23(7):619–24.
- Mohamed HA. Conservative treatment of chronic plantar fasciitis using Achilles tendon stretching. Egypt J Phys Med Rehabil. 2014;5(2):85–91.
- Jha RK, Uprety S, Shah LL. Functional outcome in chronic plantar fasciitis treated with plantar fascia stretching versus tendoachilles stretching. Nepal Orthop Assoc J. 2013;3(1):15–20.
- Carlson RE, Fleming LL, Hutton WC. The biomechanical relationship between the Achilles tendon and plantar fascia. Foot Ankle Int. 2000;21(1):18–25.
- Cheung JT, Zhang M, An KN. Effect of Achilles tendon loading on plantar fascia tension. Clin Biomech. 2006;21(2):194–203.
- Zwirner J, Ondruschka B, Hammer N. Anatomical relationship between Achilles tendon and plantar fascia. Ann Anat. 2020;228:151433.
- Matijevich ES, Scott LR, Volgyesi P. Achilles tendon stiffness and force transmission during gait. J Biomech. 2018;70:49–56.
- Thierfelder KM, Kooijman HJ, Bauer JS. Imaging and biomechanics of plantar fascia disorders. Eur J Radiol. 2018;107:68–75.Wearing SC, Smeathers JE, Urry SR. The pathomechanics of plantar fasciitis. Sports Med. 2006;36(7):585–611.
- Lemont H, Ammirati KM, Usen N. Plantar fasciitis: a degenerative process. J Am Podiatr Med Assoc. 2003;93(3):234–7.
- Riddle DL, Pulisic M, Pidcoe P. Risk factors for plantar fasciitis. J Bone Joint Surg Am. 2003;85(5):872–7.
- Irving DB, Cook JL, Young MA. Obesity and pronated foot posture as risk factors for plantar heel pain. Clin J Sport Med. 2007;17(1):37–42.
- Buchbinder R. Clinical practice: plantar fasciitis. N Engl J Med. 2004;350(21):2159–66.
- Neufeld SK, Cerrato R. Plantar fasciitis: evaluation and treatment. J Am Acad Orthop Surg. 2008;16(6):338–46.



Document Details

Submission ID
trn:oid:::16841:150583149

Submission Date
Sep 4, 2026, 11:53 AM GMT+5:30

Download Date
Sep 4, 2026, 12:53 PM GMT+5:30

File Name
PLAG FILE (2) (1).docx

File Size
77.7 KB

21 Pages

4,431 Words

24,563 Characters

turnitin Page 1 of 24 - Cover Page Submission ID trn:oid:::16841:150583149

turnitin Page 2 of 24 - Integrity Overview Submission ID trn:oid:::16841:150583149

4% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography
- Quoted Text
- Cited Text
- Small Matches (less than 14 words)

Match Groups

10 Not Cited or Quoted 4%
Matches with neither in-text citation nor quotation marks

0 Missing Quotations 0%
Matches that are still very similar to source material

0 Missing Citation 0%
Matches that have quotation marks, but no in-text citation

0 Cited and Quoted 0%
Matches with in-text citation present, but no quotation marks

Top Sources

2% Internet sources
3% Publications
0% Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

No suspicious text manipulations found.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

Match Groups

Top Sources

2% Internet sources
3% Publications
0% Submitted works (Student Papers)

Top Sources

1 Publication
Yuki Sugino, Ichiro Yoshimura, Tomonobu Hagio, Tetsuro Ishimatsu, Masaya Nag... 2%

2 Internet
studybam.com <1%

3 Publication
Yuji Okuno, Ralph Rogers, Alexander Loizides, "Chapter 3 Lower Extremity", Sprin... <1%

4 Internet
a-wanded.org <1%

5 Publication
Chawisachon Nonsri, Inthiporn Kositanurit, Apirak Tewarthnuangsri, Kornthip Jee... <1%

6 Publication
Santosh Kumar, Dinesh Kumar Yadav, Mhaveer Singh, Sapna Salar, Anjali Singh, ... <1%

7 Internet
www.bloomingtonpodiatrist.com <1%

turnitin Page 3 of 24 - Integrity Overview

turnitin Page 4 of 24 - Integrity Submission

[COMPARISON OF TWO DIFFERENT STRETCHING DURATION OF PLANTAR FASCIA AND ACHILLES TENDON ON PAIN AND FUNCTION IN PLANTAR FASCIITIS]