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Effectiveness of Short-Foot Exercises on Q-Angle and Pain in Individuals with Plantar Fasciitis

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Abstract: ***Plantar fasciitis is a common cause of plantar heel pain and may be associated with altered foot and lower-limb mechanics.[11,15,16] Short-foot exercises activate the intrinsic foot muscles and may improve foot control. This study evaluated the effect of a 6-week short-foot exercise programme on pain and Q-angle in 50 individuals with plantar fasciitis. Pain was assessed using the Visual Analogue Scale (VAS), while Q-angle was measured with a universal goniometer. Foot Function Index (FFI) and Foot and Ankle Ability Measure (FAAM) scores were also recorded descriptively. Mean VAS decreased from 7.72 ± 0.67 to 2.98 ± 0.74, with a mean change of −4.74 (95% CI −5.002 to −4.478; p < .001; Cohen's dz = −5.143). All participants demonstrated reduced VAS scores. Mean Q-angle decreased from 17.56° ± 3.84° to 16.66° ± 3.88°, with a mean change of −0.90° (95% CI −1.101 to −0.699; p < .001; Cohen's dz = −1.273). Wilcoxon sensitivity analyses confirmed significant reductions in both outcomes. FFI decreased and FAAM increased descriptively. The findings suggest that short-foot exercises may help reduce pain and improve Q-angle; however, the absence of a control group limits causal interpretation.***

Keywords: Plantar fasciitis; Short-foot exercise; Q-angle; Pain; Physiotherapy

1. Introduction

Plantar fasciitis is one of the most common causes of plantar heel pain and can produce considerable discomfort and functional limitation. It is associated with repetitive loading of the plantar fascia and may be influenced by foot posture, activity level, footwear, and other biomechanical factors. The medial longitudinal arch contributes to shock absorption and load distribution during weight-bearing, while the intrinsic foot muscles provide dynamic support to the arch.
Excessive pronation and altered foot mechanics may influence the kinetic chain and lower-limb alignment. The Q-angle, formed by the lines joining the anterior superior iliac spine to the patellar centre and the patellar centre to the tibial tubercle, is a commonly used clinical measure of frontal-plane knee alignment. Changes in foot and lower-limb mechanics may therefore be reflected in Q-angle measurements.[11,15,16]

Short-foot exercise involves active shortening of the foot by drawing the metatarsal heads towards the calcaneus while keeping the toes relaxed. The exercise targets the intrinsic foot muscles and may improve medial longitudinal arch control, foot stability, and load distribution. Previous studies have reported benefits of short-foot exercises for foot posture, pain, disability, and plantar pressure.[8,9]

Despite these findings, the effect of short-foot exercises on Q-angle in individuals with plantar fasciitis remains less clear. Therefore, the present study evaluated changes in pain and Q-angle following a 6-week short-foot exercise programme.

2. Literature Survey

Çelik et al. reported that the Turkish version of the Foot and Ankle Ability Measure demonstrated good reliability[1], validity, and responsiveness in patients with foot and ankle disorders[1]. Unver et al. found that short-foot exercises could improve foot posture, pain, disability, and plantar pressure in individuals with pes planus. Latt et al. highlighted the importance of appropriate conservative management for plantar fasciitis.

Rosdiana et al. investigated the relationship between the plantar arch, Q-angle, balance, and plantar fasciitis, supporting the relevance of examining foot and lower-limb alignment together. Dikici et al. described the navicular drop test as a useful measure related to pronation and arch collapse in plantar fasciitis. Khisty et al. reported favourable changes following short-foot exercises in individuals with flexible flat foot.

Hara et al., in a systematic review, described the potential role of short-foot exercises in improving foot posture and function. Kusagawa et al. discussed the contribution of plantar intrinsic muscles to medial longitudinal arch support. Hamstra-Wright et al. emphasized that plantar fasciitis is multifactorial, with both intrinsic and extrinsic risk factors.

3. Problem Definition

Plantar fasciitis can cause pain and functional limitations and may coexist with altered foot mechanics and lower-limb alignment. Although short-foot exercises are commonly used to improve intrinsic foot muscle function, evidence regarding their effect on Q-angle and pain in individuals with plantar fasciitis is limited. The present study was therefore undertaken to determine whether a 6-week short-foot exercise programme was associated with improvement in these outcomes.

4. Methodology / Approach

4.1 Study Design and Sample

An interventional pre-post study was conducted in 50 community participants with plantar fasciitis over 6 weeks. Simple random sampling was reported in the study protocol. Participants were aged 18–40 years. The study included individuals who stood for prolonged periods or were physically active and those reporting heel pain, with or without reduced medial longitudinal arch/flat foot.

Participants with lower-limb surgery or fracture, neurological disorders affecting gait or motor control, or rheumatoid arthritis were excluded. Ethical clearance was obtained before the study, and participants were informed about the procedure and provided informed consent.

4.2 Outcome Measures

Pain intensity was assessed using the Visual Analogue Scale (VAS). Q-angle was measured using a full-circle universal manual goniometer with the participant supine. The anterior superior iliac spine, midpoint of the patella, and tibial tubercle were identified; the midpoint of the patella served as the fulcrum. FFI and FAAM were recorded as functional outcome measures.[1,2,14]

4.3 Intervention

Participants began with warm-up exercises consisting of towel toe curls and clockwise and anticlockwise ankle circles, with 10 repetitions. The short-foot programme then progressed from sitting to standing and included dynamic heel raises. In the seated short-foot exercise, participants drew the front of the foot towards the heel while keeping the toes relaxed and the heel on the floor, holding for 5–8 seconds for 10–15 repetitions per foot. The standing short-foot exercise was performed for 10 repetitions with 5–10-second holds, followed by dynamic short-foot heel raises performed slowly and under control. The intervention was continued for 6 weeks.[8,9]

4.4 Statistical Analysis

Data were analysed using IBM SPSS Statistics for Windows, Version 26.0. Completeness and potential data-quality issues were reviewed. Descriptive statistics were calculated for participant characteristics and outcomes. Change scores were calculated as post-intervention minus pre-intervention values. Paired-samples t-tests were used for the principal VAS and Q-angle comparisons, with mean differences, 95% confidence intervals, and Cohen's dz reported. Shapiro–Wilk testing of paired differences was supplemented by distributional review. Wilcoxon signed-rank tests were performed as sensitivity analyses, and Holm adjustment was applied across the two principal comparisons. Statistical significance was set at $p < .05$. FFI and FAAM were reported descriptively because their verified scoring conventions were unavailable for inferential interpretation.

5. Results & Discussion

5.1 Participant Characteristics

Fifty participants were included in the final analysis, with complete pre- and post-intervention data. The mean age was 30.08 ± 7.23 years (range 19–40 years), and the median age was 29.50 years (IQR 14.00). Thirty-one participants (62.0%) were female and 19 (38.0%) were male.

Characteristic	Value
Sample size	50
Age, mean ± SD (years)	30.08 ± 7.23
Age range (years)	19–40
Female, n (%)	31 (62.0%)
Male, n (%)	19 (38.0%)

5.2 Pain Outcome

Mean VAS pain score decreased from 7.72 ± 0.67 at baseline to 2.98 ± 0.74 after intervention, giving a mean reduction of 4.74 points. The paired-samples t-test showed a statistically significant reduction, $t(49) = -36.367$, $p < .001$, with a 95% confidence interval of −5.002 to −4.478 and a very large standardized paired effect (Cohen's dz = −5.143). All 50 participants (100%) demonstrated lower post-intervention VAS scores. The Wilcoxon signed-rank sensitivity analysis was also significant ($p < .001$), supporting the consistency of the finding.

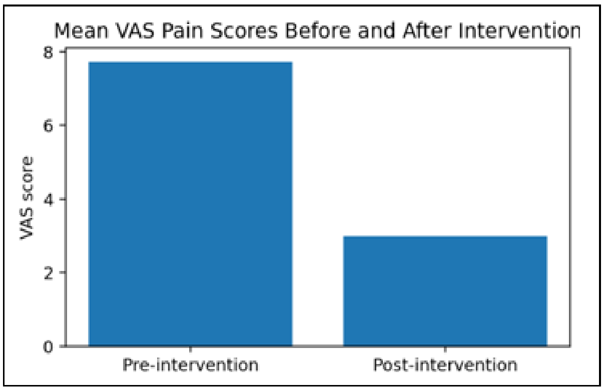

Figure 1: Mean VAS pain scores before and after intervention

5.3 Q-angle Outcome

Mean Q-angle decreased from 17.56° ± 3.84° before intervention to 16.66° ± 3.88° after intervention, corresponding to a mean reduction of 0.90°. The paired-samples t-test demonstrated a statistically significant difference, $t(49) = -9.000$, $p < .001$, with a 95% confidence interval of −1.101° to −0.699° and a large standardized paired effect (Cohen's dz = −1.273). Thirty-five participants (70%) demonstrated a reduction in Q-angle, while 15 (30%) showed no change; no participant showed an increase. The Wilcoxon signed-rank sensitivity analysis also demonstrated a significant reduction ($p < .001$).

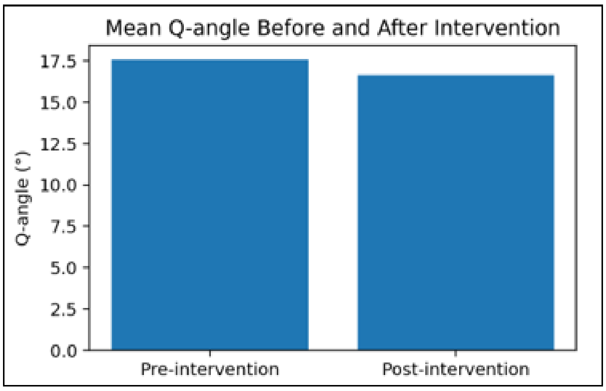

Figure 2: Mean Q-angle before and after intervention

Outcome	Pre Mean ± SD	Post Mean ± SD	Mean Change	95% CI	t(49)	p	Cohen's dz
VAS	7.72 ± 0.67	2.98 ± 0.74	−4.74	−5.002 to −4.478	−36.367	<.001	−5.143
Q-angle	17.56° ± 3.84°	16.66° ± 3.88°	−0.90°	−1.101 to −0.699	−9.000	<.001	−1.273

5.4 Functional Outcomes

FFI values decreased descriptively from 0.650 ± 0.047 to 0.240 ± 0.072, while FAAM values increased from 0.246 ± 0.084 to 0.809 ± 0.093. These changes were directionally favourable within the recorded dataset; however, inferential conclusions were not drawn because the verified scoring units, direction, valid ranges, and scoring rules were not available in the final analysis.

5.5 Discussion

The present study demonstrated significant within-participant reductions in pain and Q-angle following the short-foot exercise programme. The reduction in VAS was particularly marked, with every participant showing improvement. This may be related to improved activation and control of the intrinsic foot muscles, which can enhance dynamic medial longitudinal arch support and foot stability during weight-bearing.

The Q-angle reduction was smaller in absolute magnitude than the pain reduction, although it was statistically significant and occurred in 70% of participants. Improved control of foot posture may influence the lower-limb kinetic chain and provide a possible explanation for the observed change. However, Q-angle is influenced by anatomical and measurement-related factors, and the observed 0.90° reduction should not be interpreted as definitive structural correction.

The descriptive changes in FFI and FAAM were consistent with an overall improvement in function, but these outcomes require standardized scoring verification before inferential interpretation. The agreement between paired t-tests and Wilcoxon sensitivity analyses strengthens confidence that the principal VAS and Q-angle findings were not dependent solely on parametric assumptions.

The findings should be interpreted cautiously because the study did not include a control or comparison group. Therefore, the observed improvements cannot be attributed exclusively to short-foot exercises; natural recovery, changes in activity, participant expectations, or other factors may have contributed. The sample size of 50 participants also limits generalizability.

6. Conclusion

A 6-week short-foot exercise programme was associated with significant reductions in pain intensity and Q-angle in the 50 participants studied. VAS decreased substantially, with all participants showing improvement, while Q-angle decreased by 0.90° and 70% of participants demonstrated a reduction. FFI decreased and FAAM increased descriptively, suggesting possible functional improvement, although these measures were not analysed inferentially. Short-foot exercises may therefore be a useful conservative physiotherapy approach for individuals with plantar fasciitis; however, controlled studies are needed to establish a causal treatment effect.

7. Future Scope

Future studies should include larger samples and randomized controlled designs with an appropriate comparison group. Longer follow-up should be used to determine whether improvements in pain and Q-angle are maintained. Future research should apply standardized scoring procedures for FFI and FAAM, include objective foot-posture measures such as the Navicular Drop Test, and use reliable Q-angle measurement procedures. Comparative studies could also evaluate short-foot exercises against stretching, strengthening, manual therapy, orthoses, or combined physiotherapy programmes.

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