The Immediate Effects of Short Foot Exercise on Dynamic Knee Valgus in Individuals with Patellofemoral Pain Syndrome

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Summary

Single Leg Squat (SLS) is a functional movement assessment for individuals with patellofemoral pain (PFP), often exacerbating the dynamic knee valgus and medial knee displacement (MKD). While faulty foot posture has been linked to poorer frontal plane kinematics, the influence of sort foot exercises (SFE) on SLS mechanics remain unexplored. This study examines the effects of SFE on lower extremity kinematics during SLS. Within subjects, repeated measure design was conducted with five individuals with PFP (Sex:4F;1M, Age:23.92 ± 1.92 years; Height: 170.2 ± 7.96; Mass: 74.19 ± 10.01kg). 3D motion capture was used to assess hip, knee, and ankle kinematics during SLS, with and without SFE. Preliminary results indicate no significant differences in frontal plane kinematics ($p>0.05$). Full data collection ($n=18$) will conclude in June 2025, with findings presenting at ISB 2025. Understanding foot posture's role in knee mechanics could inform clinical interventions for improving movement patterns in PFP individuals.

Introduction

Single Leg Squat (SLS) is often painful in individuals with patellofemoral pain (PFP) and often exacerbates aberrant lower extremity mechanics, specifically dynamic knee valgus [1]. Dynamic knee valgus can be evaluated using 3D motion capture by assessing medial knee displacement (MKD). Although studies have found trends in lower extremity deficits during the SLS, commonly linked with MKD, PFP is a heterogeneous pathology. Individuals with PFP may employ different movement strategies stemming from various kinematic deficits during a SLS. While faulty foot posture during SLS is associated with poorer frontal plane kinematics, the effects of neutral positioning of the foot using short foot exercises (SFE) during SLS have not been studied yet [2].

Methods

This is a within-subjects, repeated measures design. Five individuals with PFP (Sex: 4F,1M; Age: 23.92 ± 1.92 years; Height: 170.2 ± 7.96; Mass: 74.19 ± 10.01kg) were recruited for this study. Retroreflective markers were placed on the anatomical landmarks using double-sided tape to assess lower extremity kinematics during a single leg squat (SLS) using a Qualisys 3D motion capture system. Participants were instructed to squat to an angle of 60° of knee flexion over a 2-second period. Thus, it took them 4 seconds, as monitored by a digital metronome, to perform the single leg squat. A trial was valid if the participant performed the single leg squat to at least 60° of knee flexion within a 4-second period without losing balance. Participants performed the SLS three times without SFE, followed by three more trials with SFE. Marker trajectories during all SLS trials were used to derive frontal plane joint angles for the hip, knee, and ankle. Peak hip adduction, knee abduction, and ankle eversion angles during each SLS were extracted, averaged within each participant and SFE condition, and compared between pre- and post-intervention visits using paired t-tests.

Results and Discussion

Compared to the SLS without SFE, the SLS with SFE did not show any statistically significant differences in hip, knee, or ankle frontal plane kinematics (all $p>0.05$). This is the preliminary finding of our project. We anticipate completing the results section with the full 18 subjects at the end of data collection in June 2025. We plan to present the full data set at the International Society of Biomechanics conference in 2025.

Conclusions

Individuals with PFP did not show improvement in frontal plane kinematics with SFE. We will gain a better understanding of changes in mechanics by performing SFE to bring the foot into a neutral position once we complete this study. Clinicians need to find better ways to apply interventions at the foot to improve knee frontal plane kinematics by reducing knee abduction.

References

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[2] Jaffri AH et al. (2023). *J Athl Train*, **58**: 941-951.