Investigating Knee Force Profiles and Gait Patterns in Patients with Knee Osteoarthritis

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Summary

This study investigates how patients with knee osteoarthritis (KOA) minimize the first knee contact force (KCF) peak during gait and compares them to those who do not exhibit this pattern. Gait data were collected using optical motion capture, and KCF was computed using musculoskeletal models. The findings showed that individuals without the first KCF peak experienced more severe symptoms and distinct kinematic and kinetic adaptations than those with both peaks.

Introduction

Some patients with KOA walk with a gait pattern that reduces the first KCF peak during gait[1], potentially as a protective mechanism. Understanding how these adaptive patterns are formed and differ from other patients with KOA gait patterns could offer valuable insights for developing gait retraining strategies. This study aims to explore how the adaptive strategy of minimizing the first KCF peak is achieved and to compare the differences between patients with KOA who exhibit this gait pattern and those who do not.

Methods

In this cross-sectional study, 55 individuals with KOA were divided into two groups based on gait patterns (no first peak and two peaks). Gait data were recorded using a motion capture system (Qualisys, Sweden), and musculoskeletal models (Anybody Technology, Denmark) were used to compute the KCF. KOOS and magnetic resonance imaging scans were conducted to assess patient-reported outcomes and knee joint structures, which were evaluated using BLOKS scoring.

Results and Discussion

Among the participants, 22 lacked the first KCF peak in their gait pattern, while 34 displayed it. Those without the peak had higher body mass and BMI ($P = 0.018$, $P = 0.002$), greater pain ($P = 0.002$), worse KOOS scores ($P \leq 0.003$), and slower walking speed ($P < 0.001$).

The group without the first peak exhibited increased hip flexion and adduction, reduced hip extension and internal rotation, and altered knee kinematics. Joint moments showed reduced hip extension/flexion, increased hip abduction/external rotation, and modified knee moments. KCF was lower during the loading response phase. No difference in knee structures was observed in the BLOKS scores.

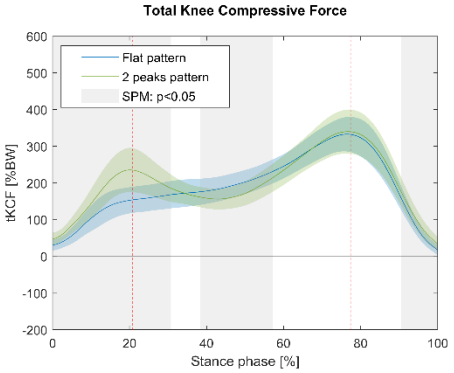

Figure 1: Mean knee compressive forces (normalized to BW) for the flat (blue) and two-peak (green) groups. Shaded areas show standard deviation, with gray regions marking significant differences.

These findings suggest that individuals with greater pain or limitations may adopt altered gait patterns. However, research in healthy individuals has shown that some also walk without the first KCF peak [2]. This raises questions about causality—whether altered gait patterns exacerbate pain, result from it, or serve as a compensatory strategy with unintended consequences, like cartilage underloading.

Conclusions

Individuals with KOA who lack the initial KCF peak experience more severe symptoms and distinct kinematic and kinetic adaptations than those with both peaks. No difference in knee joint structures was observed between groups.

Acknowledgments

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References

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