

A GAIT MODIFICATION TO REDUCE THE EXTERNAL ADDUCTION MOMENT AT THE KNEE: A CASE STUDY

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INTRODUCTION

Knee osteoarthritis (OA) is the most common form of arthritis, and affects approximately one-third of the elderly population. The medial tibiofemoral compartment is most commonly involved. This is due, in part, to the ground reaction force vector passing medial to the knee joint center during gait. This distance increases with genu varus malalignment, resulting in an increased external adduction moment at the knee (KEAM). A high KEAM has been previously associated with medial tibiofemoral OA disease progression and severity (Mundermann, et al., 2004, Miyazaki, et al., 2002). Reduction of the KEAM has been reported after high tibial osteotomy, and to a lesser extent with the use of conservative measures such as wedged orthoses (Prodromos, et al., 1985, Kerrigan, et al., 2002). In an asymptomatic, varus-aligned population without diagnosed knee OA, reducing the KEAM may serve to delay or prevent the onset of the disease.

Recently, walking with an increased medial-lateral trunk sway has been proposed to reduce the KEAM (DeMarre, et al., 2006). However, this could lead to adverse effects at the lumbar spine. Our research group has been studying the use of real-time feedback to improve abnormal lower extremity dynamic alignment in runners with patellofemoral pain. We believe these techniques may be beneficial in individuals with knee OA as well. Therefore, the purpose of this proof of concept study was to assess the effect of verbal and visual feedback on the KEAM in an asymptomatic

individual with genu varus malalignment. We hypothesized that the subject would be able to reduce the KEAM in a single session using mirror and verbal feedback.

METHODS

The subject for this case study was an asymptomatic 29 year-old male (BMI: 28.3) with severe genu varus malalignment. The frontal plane mechanical axis of his shank was measured at 13° from the vertical (Hinman, et al., 2006). Retro-reflective markers were placed on the lower extremity. Three-dimensional motion analysis was performed as the subject walked at a self-selected speed along a 25m walkway. Kinematic data were captured using an 8-camera VICON motion analysis system (120 Hz). Kinetic data were captured using a Bertec force platform (1080 Hz).

The subject first walked with his normal gait pattern. He was then given verbal instructions to internally rotate his hips, and to bring his knees closer to midline as he walked. A mirror was positioned directly anterior to the subject's line of progression to provide a visual component to the feedback. The subject was provided approximately ten minutes to practice his new gait pattern. Gait analysis was again performed on the modified gait pattern. Five trials were averaged for each condition, and compared to a normative group mean.

RESULTS AND DISCUSSION

The subject was able to modify his gait without any musculoskeletal complaints. Subjectively, he felt the modified gait

visually approximated a normal gait pattern. The subject increased his peak hip internal rotation by 8°, providing evidence of an appropriate response to the feedback (Table 1). A reduction in both the knee varus angle and KEAM are seen throughout most of stance (Figure 1). The first peak of the KEAM was reduced by 28%, and brought within 1 SD of the normative group mean. Further, this order of magnitude of change surpasses the 6-13% reduction seen with wedged orthoses (Crenshaw, et al., 2000, Kerrigan, et al., 2002).

This case study has demonstrated the feasibility of using visual and verbal feedback in an individual with genu varus malalignment to reduce the KEAM. Currently, our lab is investigating the use of real-time angular feedback to improve dynamic valgus malalignment during running in subjects with patellofemoral pain.

Based on the preliminary results of this case study, we believe these techniques could be applied to individuals with genu varus malalignment and a high KEAM.

SUMMARY/CONCLUSIONS

The results of this case study suggest that individuals appear to be able to reduce the KEAM with a single session of feedback. We hope to develop an intervention for individuals with identifiable genu varus malalignment to reduce the risk of development of knee OA.

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Table 1: Comparison between mean (SD) baseline and modified discrete variables with normative values for peak hip internal rotation angle, knee adduction angle, and peak knee external adduction moment

	Peak Hip Internal Rotation Angle (deg)	Peak Knee Adduction Angle (deg)	First Peak Knee External Adduction Moment (Nm/kgm)
Subject Baseline	4.6 (0.4)	10.6 (0.3)	0.47 (.02)
Subject Modified	13.3 (2.8)	6.5 (0.6)	0.34 (.02)
Normative Mean	3.0 (7.7)	1.7 (4.8)	0.33 (.10)

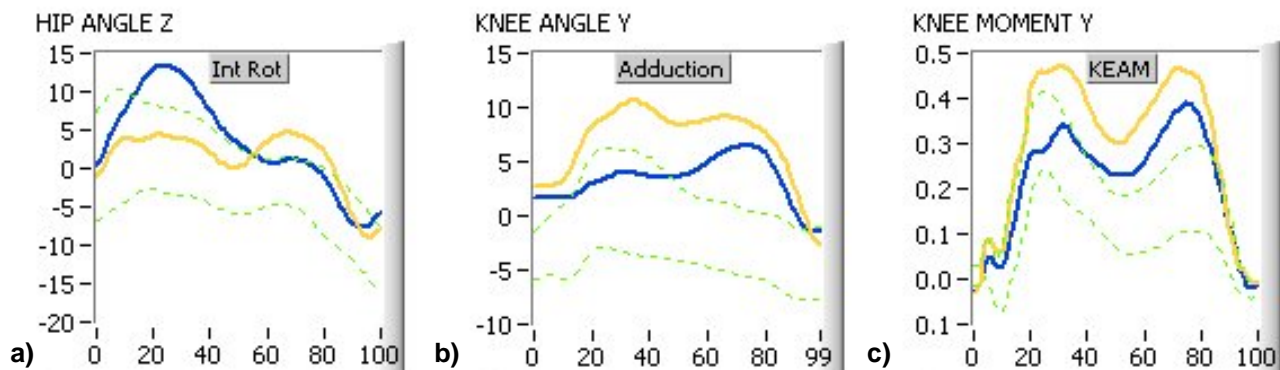


Figure 1: Comparison of a) hip rotation, b) knee adduction angle and c) knee external adduction moment during normal (light line) and realigned (dark line) gait. Mean normative walking data (\pm 1 SD) presented in dashed lines. Angles reported in degrees, moments in Nm / kg*m.