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The effect of static standing posture on dynamic walking kinematics: Comparison of a thigh wand versus a patella marker

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ABSTRACT

A thigh wand affixed to the lateral and distal parts of the thigh has typically been used as part of the 3-D computerized gait analysis marker set and model to assess hip rotation in walking. A marker placed on the patella has been proposed as an alternative. The purpose of this study was two-fold. First, determine if the static standing hip posture affected kinematic gait data of hip rotation. Second, determine which marker within the configuration, (a thigh wand or patella marker) performed more consistently with the variation in static hip position. Ten adult subjects participated in this study. Three static trials were captured for each subject (typical hip rotation, internal hip rotation, external hip rotation) and processed twice; once using the thigh wand and a second time using the patella marker. The subject then walked typically with one trial randomly selected for analysis. When using a thigh wand, mean dynamic hip rotation determined in stance phase was significantly different (7° internal to 17° external) with the three static hip rotation variations. For the patella marker, there was no significant difference in gait hip rotation (7° external) with the three static hip rotation postures. In conclusion, because gait hip rotation was more consistently determined with changes in standing static hip rotation postures, it is recommended that a marker on the patella be used in the conventional gait marker set in lieu of a thigh wand.

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1. Introduction

Hip rotation during gait is an important kinematic variable used in clinical decision making and particularly in planning femoral derotational osteotomies. Therefore, accurate hip rotation calculations are critical in gait analysis studies. Three dimensional computerized gait analysis has typically used a thigh wand affixed to the lateral and distal part of the thigh as part of the marker set and model to assess hip rotation in walking [1]. Kinematic hip rotation measurements using a thigh wand have been shown to have large variability between laboratories [2]. Soft tissue artifact has been proposed as a primary source of that variability [3,4]. Marker configurations using a distal thigh wand marker were able to detect only about 50% of the actual range of motion during a standing internal/external hip rotation task [4–6] suggesting soft tissue artifact at the thigh as the primary factor. In lieu of a thigh wand, Wren et al. have suggested using a patella marker, which was reported to detect 98% of the actual hip rotation range of motion [5].

It is not clear how different marker configurations impact hip rotation for the typical clinical gait analysis process. The patella marker and the thigh wand are technical markers that require data capture in a static standing trial using a Knee Alignment Device (KAD) to determine rotation values (offsets) to place these markers into the anatomical coordinate system. If a marker does not accurately represent the position of the hip during standing data capture, the technical marker will not be placed into the correct anatomical plane for the dynamic trial. This is particularly problematic if the static and dynamic positions of the hip vary from one another.

The purpose of this study was two-fold: (1) determine if the static standing hip posture affects kinematic gait data of hip rotation in typical clinical gait analysis processes for the conventional gait model; (2) determine if a thigh wand or patella marker performed more consistently in determining dynamic hip rotation when subjects had a variety of hip rotation positions in the static trial.

2. Methods

2.1. Subjects

Approval from the local institutional review board was obtained to conduct this study. Ten adult subjects without any lower extremity orthopedic conditions

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