

Use of a patella marker to improve tracking of dynamic hip rotation range of motion

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Abstract

Hip rotation during gait has traditionally been measured using thigh wand markers. Hip rotation data calculated using thigh wands shows large variability between different laboratories and underestimates the rotation movement. This study investigated effectiveness of a patella marker in tracking hip rotation range of motion in comparison with traditional thigh wands. In controlled trials of isolated hip internal–external rotation, the patella marker detected $98 \pm 8\%$ of the actual range of motion, compared with $53 \pm 10\%$ for a distal thigh wand and $43 \pm 13\%$ for a proximal thigh wand. The patella marker produced the smoothest hip rotation curves and the smallest hip rotation range in walking, and results from the patella marker did not depend on walking speed. These results suggest that the patella marker is less vulnerable to wobbling, inertial effects, and soft tissue movement than traditional thigh wands. The use of patella markers with knee alignment devices may therefore allow for more accurate measurement of hip rotations during clinical gait analysis than is currently possible using traditional thigh wands.

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1. Introduction

Gait analysis is a useful tool for treatment decision-making in orthopaedics. However, for gait analysis to be more widely adopted in surgical planning, improved accuracy of the kinematic data is crucial. The repeatability of kinematic data has been shown to be best for sagittal plane motions (flexion/extension), followed by coronal plane motions (ab/adduction), with the least reliable data seen in transverse plane motions (rotation) [1–3]. This is due to variability in marker placement, propagation of errors from one segment to the next, and soft tissue artifacts [2,4].

Hip rotation is a clinically important measurement that is often used in planning femoral derotation osteotomies.

However, even with extreme care and skill in marker placement, kinematic measurements of hip rotation during gait cannot always be relied upon in surgical planning. Greater accuracy is critical for hip rotation kinematics to be used more widely in planning femoral derotational osteotomy surgery. With more accurate data, hip rotations could be used to decide not only whether or not an osteotomy should be done, but also how much to rotate the bone.

Hip rotations have traditionally been measured using thigh wands, which consist of a marker at the end of a stick [5,6]. The wands are taped to the lateral thigh and were originally used to extend the thigh marker away from the body to prevent colinearity with the hip and knee joint centers. Hip rotations calculated using thigh wands have large variability between different laboratories [3,7]. Thigh wands also greatly underestimate the rotation movement, recording only 40–70% of the actual hip rotation [8].

We hypothesized that a marker placed over the patella would be less affected by soft tissue movement and would

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