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Soft Tissue Artifact Causes Significant Errors in the Calculation of Joint Angles and Range of Motion at the Hip

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Research Highlights

- Soft tissue artifact (STA) was measured dynamically using dual fluoroscopy (DF)
- Maximum STA was 5.4 cm for the greater trochanter marker during hip rotation
- Significant errors in joint angles occurred in all anatomical planes
- Range of motion was reduced for skin marker measurements relative to DF
- During walking RMS angle errors were unchanged by marker choice or hip constraints

Abstract

Soft tissue movement between reflective skin markers and underlying bone induces errors in gait analysis. These errors are known as soft tissue artifact (STA). Prior studies have not examined how STA affects hip joint angles and range of motion (ROM) during dynamic activities. Herein, we: 1) measured STA of skin markers on the pelvis and thigh during walking, hip abduction and hip rotation, 2) quantified errors in tracking the thigh, pelvis and hip joint angles/ROM, and 3) determined whether model constraints on hip joint degrees of freedom mitigated errors. Eleven asymptomatic young adults were imaged simultaneously with retroreflective skin markers (SM) and dual fluoroscopy (DF), an X-ray technique with sub-millimeter and sub-degree accuracy. STA, defined as the range of SM positions in the DF-measured