ERROR ASSOCIATED WITH THE USE OF AN ELECTROMAGNETIC MOTION CAPTURE SYSTEM DURING FULL-ARC SHOULDER INTERNAL AND EXTERNAL ROTATION

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Background and Purpose: Recent studies have suggested that errors may occur when using electromagnetic (EM) tracking devices to measure shoulder rotational motion. The purpose of this study is to investigate the magnitude of measurement error between an inclinometer and a 3-D EM tracking system throughout maximal internal and external rotation (IR/ER) of the dominant arm.

Subjects: 31 females and 21 males completed the study, ages 20-60.

Methods: One examiner placed the dominant arm of a subject, in a seated position, at 90° of both shoulder abduction and elbow flexion. The shoulder was then passively placed, with confirmation via an inclinometer, into each of the following positions: neutral rotation, 20° increments of IR, 45° & 90°of ER, and end-range IR and ER. A 3-D EM tracking system captured all scapular and humerothoracic kinematics at these each of these static positions.

Analysis: A paired t-test with Bonferroni corrections was used to analyze data for differences in values between the EM system and inclinometer.

Results: There were significant differences between measurement systems at all positions of IR & ER, except for neutral IR/ER and 45° of ER with EM values being smaller than those gathered with the inclinometer. Absolute error between measurement systems increased from 0.5° at neutral to 22.2° at end-range IR. ER error increased from 1.0° at 45° to 25° at end-range. Root mean square error ranged from 10.7°-14.6° for IR and 7.4°-11.6° for ER.

Conclusions: 3-D EM tracking systems appear to underestimate both maximal IR/ER humerothoracic motion compared to standard clinical measures. Further research is needed to establish an offset for IR/ER values gathered with an EM system in order to extrapolate to expected clinical motion values.

Implications: Clinicians should use caution when comparing shoulder rotational values gathered with an EM system vs. clinical measures, such as an inclinometer.