

## THE EFFECT OF ELBOW AXIS DEFINITION ON THE CALCULATION OF FLEXION-EXTENSION AND ABDUCTION-ADDUCTION ANGLES FOR THE BOWLING ARM IN CRICKET

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**INTRODUCTION:** The standard protocols for testing whether a bowler is extending his/her arm illegally (by more than 15°) during the period from upper arm horizontal to ball release leave some flexibility of interpretation as to exactly how the axes should be defined. The purpose of this paper was to examine the effect of different elbow axis definitions on the flexion-extension and abduction-adduction angles calculated.

**METHOD:** The elbow axis was defined in three different ways. In all three procedures the long axis of the upper arm was defined by the line joining the elbow and shoulder joint centres and the upper arm plane was defined by the shoulder joint centre and the markers attached to the skin over the lateral and medial epicondyles at the elbow. Within this plane the elbow flexion-extension axis was defined in three different ways:

1. Perpendicular to the long axis of the upper arm (Lloyd et al., 2000).
2. As the line joining the medial and lateral epicondyles (Alderson et al., 2004).
3. Such that the lower arm folds on top of the upper arm when fully flexed.

Kinematic data was collected of a subject performing controlled elbow flexion and extension using a Vicon motion analysis system with markers placed around the shoulder, elbow and wrist joints. The coordinates of the markers were then exported and the flexion-extension and abduction-adduction angles were calculated using the three different angle definitions.

**RESULTS AND DISCUSSION:** The three different axis definitions resulted in almost identical flexion-extension angles with the maximum difference being less than 1° over a trial from a fully flexed position to fully extended. Much larger differences were found for the abduction-adduction angle over the same movement with a maximum difference of 15° although the abduction-adduction angles were less than 1° different when the flexion-extension angle was greater than 150° (180° = straight position). The abduction-adduction angle calculated using the third definition showed less variability than when calculated using the other two methods, and this is probably due to the elbow axis definition being closer to the anatomical elbow axis than in definitions 1 and 2. While only small differences were found in flexion-extension angle in these controlled trials, in bowling trials there can be forced increases in abduction and the differences in the three methods may be greater in those circumstances.

**CONCLUSION:** The next step is to test a variety of bowlers and establish the effect of the different axis definitions on the calculated flexion-extension and abduction-adduction angles.

### REFERENCES:

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