INTERNAL AND EXTERNAL ROTATION OF THE SHOULDER: EFFECTS OF PLANE, END RANGE DETERMINATION, AND SCAPULAR MOTION

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INTRODUCTION

Although many of the traditional studies of shoulder motion have primarily focused on shoulder elevation (Poppen et al., 1976), there has been considerable interest of late in measuring internal and external rotation along the long axis of the humerus (Reagan et al., 2002). Study of this motion is important for two main reasons. First, the available range of internal and external rotation impacts shoulder function, from simple activities of daily living, such as hair combing, to more complex tasks required by athletes and occupational workers. Secondly, measurement of internal and external rotations can be used as indicators of capsular tightness. The purpose of this study was to assess the effects of (1) end range determination (active vs. passive), (2) scapular motion, and (3) testing plane on internal and external rotation.

METHODS

Sixteen healthy subjects (mean age, 23.3 years) were recruited and instrumented with a six-degrees-of-freedom magnetic tracking device (Polhemus 3Space Fastrak Colchester, VT). Humerothoracic and glenohumeral motion were measured during active and passive humeral rotations in four clinically significant positions (arm at side and 90 degrees of elevation in the coronal, scapular, and sagittal plane). The first receiver was placed on the spinous process of the third thoracic vertebra. The second receiver was mounted on the distal forearm portion of a custom made Orthoplast splint positioned on the elbow with elastic straps. The final receiver was positioned over the scapula after mounting it on a custom made and previously validated (Karduna et al., 2001) scapular-tracking device machined from plastic. The dominant arm of each subject was supported by a jig, inserted into the Orthoplast splint, which was affixed to a wooden stand (Figure 1).

Figure 1: Experimental setup.

For passive motion, investigator applied torque and EMG activity (Myopac Jr. Run Technologies, Mission Viejo, CA) were measured. EMG was recorded from the pectoralis major (sternal head), trapezius (upper fibers), middle deltoid and infraspinatus. The chief purpose of these muscle recordings was to ensure that there...
was minimal muscle activity during passive positioning of the arm.

RESULTS

Passive humerothoracic motion was significantly greater than active humerothoracic motion for internal (p<0.006) and external rotations (p<0.01) in all planes (Figure 2).

A significant effect of motion type was found between passive humerothoracic and passive glenohumeral motion in six of seven conditions (p<0.002) (Figure 3).

Passive humerothoracic motion showed a significant effect of plane for internal rotation (p<0.001) but not for external rotation (p=0.584) (Figure 4).

DISCUSSION

End range determination and scapular motion had a significant effect on both internal and external rotation, while plane only had an effect on internal rotation. The least effect of scapular motion was observed for motion in the scapular plane. Measurements of internal and external rotation are dependent on the plane tested and how end range is determined. Additionally, if the scapula is not stabilized, a significant amount of motion may be occurring at the scapulothoracic articulation.

REFERENCES


![Figure 2](image2.png): Mean (+/- sd) differences between passive and active humerothoracic motion. *p<0.05

![Figure 3](image3.png): Mean (+/- sd) differences between passive humerothoracic and passive glenohumeral motion. *p<0.05

![Figure 4](image4.png): Mean (+/- sd) for passive humerothoracic motion across all seven conditions tested. *p<0.05