

Determination of In-Vivo Glenohumeral Translation During Loaded and Unloaded Arm Elevation

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The purpose of this study was to investigate humeral translation relative to the glenoid in-vivo during loaded and unloaded shoulder abduction.

CT scans of 9 healthy shoulders were acquired and 3D models were created. The subject was positioned in front of a fluoroscope and motions were recorded during active abduction. The subjects performed two trials of holding a 3kg weight and unload. 3D motions were determined using model-based 3D-to-2D registration to obtain 6 degrees of freedom kinematics. Glenohumeral translation was determined by finding the location on the humeral head with the smallest separation from the glenoid. Humeral translation was referenced to the glenoid center in the superior/inferior direction.

The humerus moved an average of 2 mm, from inferior to central on the glenoid, during arm abduction for both conditions. The humeral head was centered within 1mm from the glenoid center above 70°. There were no statistically significant differences for both conditions. The standard deviation decreased gradually over the motion, with significantly lower variability at the end of abduction compared to the initial unloaded position.

We assumed that the humeral translation to the center of the glenoid provides maximum joint congruency for optimal shoulder function and joint longevity. We believe this information will lead to better strategies to prevent shoulder injuries, enhance rehabilitation, and improve surgical treatments.