INTRODUCTION

Many joint damage mechanisms in overhand athletes are thought to be associated with inadequate control of humeral head translations. Normal shoulders stabilize the humeral head within a small envelope motion on the glenoid, with the humeral head shifting postero-superiorly (or in the other directions) during abduction and external rotation [1][2]. Glenohumeral translations during shoulder rotation at the zero position – the posture most relevant to overhand throwing – remain unknown and unstudied.

The purpose of this study was to investigate glenohumeral translation in-vivo during active internal/external rotation at the zero position - simulating a throwing motion. We assumed humeral translations would be limited within a small range, perhaps a few millimeters, in healthy shoulders.

METHODS

Ten healthy shoulders (8 males, 2 females; average 31.1 years, 27 to 38 years old) were studied. All subjects provided informed consent to participate in this IRB approved study. 3D models of the scapula and humerus were created from CT images acquired at 0.5 mm intervals and single-plane fluoroscopic data were recorded during active rotation (0°–140°) at the zero position. 3D motions of the scapula and humerus were determined using model-based 3D-to-2D registration to obtain 6 degrees-of-freedom shoulder kinematics (Figure 1). Glenohumeral translation was determined by finding the location on the humeral head with the smallest separation from the plane of the glenoid. Humeral translation was referenced to the glenoid center in the superior/inferior direction. Motion data were grouped into 10° interval of rotational motion.

RESULTS

The humeral head translated an average of 1.7 mm, from an inferior location to the glenoid center, during arm active rotation at zero position (Figure 2). The humeral head was centered within 1 mm from the glenoid center below 80° ER. The intersubject variability in glenohumeral translation was within 0.6 mm across the rotation range.

DISCUSSION

The healthy throwing shoulder is believed to provide sufficient glenohumeral stability to avoid pathological joint changes, while the pathologic should manifests a range of instabilities and lesions (including SLAP lesion, subacromial impingement and internal impingement). There is little information on the motions of the healthy or injured throwing shoulder during cocking or throwing, making it difficult to understand the specific etiologies of throwing related injuries. Humeral translation confined within a small envelope near the center of the glenoid provides maximum joint congruency and is likely favorable to avoid pathologic changes. We believe 3D fluoroscopic analysis of shoulder kinematics can provide information important for improved understanding of throwing shoulder function and this information will lead to better strategies to prevent shoulder injuries, enhance rehabilitation, and improve surgical treatments.

REFERENCES
