INTRODUCTION

Humeral translation is an important mechanism believed to be associated with several shoulder pathologies. For example, abnormal superior translation of the humeral head is believed to be one of the major causes of shoulder impingement syndrome (Deutsch, 1996; Wong, 2003). In order to detect abnormal translations of the humeral head, a precise and accurate measurement is necessary.

There are numerous techniques used to monitor humeral head translation. The most common techniques utilized include roentgenogram (X-ray), and magnetic resonance imaging (MRI). Fluoroscopy, which is an imaging technique based on x-ray technology, is also commonly utilized to allow real time digital collection of images (Livyatan, 2003; Pfirrmann, 2002).

There is a scarcity of research looking at the accuracy of imaging techniques in monitoring translations of the humeral head. Therefore, the purpose of this study was to assess the accuracy of fluoroscopy in measuring humeral head translation in cadaver bones. In particular, we wanted to determine projection errors associated with motion perpendicular to the field of view of the fluoroscope.

METHODS

Eight glenohumeral joints were harvested from two female and two male human cadavers. All the muscles, ligaments, capsules, labrum, and tendons surrounding the shoulder girdle were detached and only the scapula and the humerus were preserved. A GE (OEC) 9800 fluoroscopy unit was used to monitor the translation of the humeral head.

A shoulder jig was utilized to secure the scapula and the humerus (Figure 1). The specifically designed jig enabled the scapula to be manipulated, allowing it to move with three degrees of freedom (i.e. anterior/posterior tilt, upward/downward rotation, internal/external rotation). The humerus was mounted on a translation device that enabled the investigator to move the bone in millimeter increments.

Figure 1: Shoulder Jig
During data collection, the scapula was placed in a predetermined position, based on a previous study, which mimics the position of the scapula when the arm is ab ducted, *in-vivo*. The humerus was superiorly translated in 2 mm increments, and fluoroscopic images were taken. A total of three images per scapular position were collected while the humerus was at 90 degrees of abduction in the scapular plane. An arc on the humeral head was digitized and used to calculate the geometric center. Additionally, the mid-distance between two digitized points on the glenoid face served as the origin of translation of the geometric center.

**RESULTS AND DISCUSSION**

The error for a given translation was defined as the difference between the known translation and the measured translation. The difference between the two translations was then used to calculate the root mean square (RMS) errors.

During humeral head translation, when the scapula was at neutral position the lowest error was recorded at 0.48 mm (Figure 2).

![Figure 2: Measured humeral head translation root mean square error for different scapular positions.](image)

The largest error was recorded when the scapula was positioned in downward rotation and internal rotation, 0.58 and 0.60 mm, respectively. The results suggest that when the scapula is in plane (i.e. neutral) from the view of the fluoroscope, the amount of measured translation error is less. The amount of error recorded range between 0.48 – 0.60 mm across scapular orientations.

**SUMMARY/CONCLUSIONS**

The error measured for this preliminary study is larger than expected. Further analysis will be performed by the investigator to determine the source of error generated by this technique. To our knowledge, this is the only study that has validated the measuring technique using 2-D imaging.

**REFERENCES**


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