DISLOCATION BY IMPINGEMENT IN REVERSE SHOULDER ARTHROPLASTY

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INTRODUCTION
Reverse shoulder arthroplasty (RSA) is a relatively new type of surgery for patients with shoulder osteoarthritis combined with severe rotator cuff damage. RSA effectively reverses the orientation of the ‘ball and socket’ in the glenohumeral joint, increasing the moment arm of the deltoid and improving the abduction range of motion of the shoulder. While the surgery has been successful in reducing pain and improving mobility, joint instability leading to dislocation remains a common complication. Impingement of the humeral RSA component against the scapula has been reported as a common mechanism of dislocation [1, 2]; however, biomechanics and joint stability in this situation have not previously been investigated. The purpose of this study was to determine the effects of implant geometry on the force required to dislocate an RSA joint through impingement.

METHODS
An existing shoulder simulator, which was developed to investigate factors affecting RSA stability, was adapted for this study. RSA components (Delta Xtend, DePuy) were implanted in an artificial scapula and humerus (Sawbones 1050 and 1028, Pacific Research Labs). The scapula was fixed in a frame, and three cables attached to deltoid insertion points on the humerus were fed through wrapping points on the scapula, and then coupled to pneumatic actuators representing anterior, middle, and posterior heads of the deltoid. Deltoid forces were adjusted using manual pressure regulators and recorded using inline load cells. The application point for the dislocation force was drilled and reamed to fit one end of a fourth load cell, through which the load was applied.

Trials were carried out in random order according to a three-factor, four-replicate factorial design. The factors were as follows: (i) glenoid component (glenosphere) eccentricity (standard or inferior offset), (ii) glenosphere diameter (38 mm or 42 mm), and (iii) humeral cup depth (high mobility or retentive). A humeral cup thickness of 6 mm was used for all trials. Deltoid forces were applied to hold the humerus in position. Pressures were adjusted manually until the anterior, middle, and posterior deltoid load cells measured 30 N, 65 N, and 30 N, respectively. This corresponded to a neutral, impingement-free posture and a mean humeral abduction angle of 40 degrees. A force was applied at the distal end of the humerus, perpendicular to the epiphyseal axis, adducting the arm until impingement against the scapula caused the joint to dislocate. Peak force to dislocate was measured for each trial with a load cell.

RESULTS
Changing glenosphere offset from standard to eccentric increased force to dislocate by 14 N. Increasing glenosphere diameter from 38 mm to 42 mm increased force to dislocate by 10 N (p < 0.001 for both factors). Humeral cup depth did not significantly influence the force to dislocate the joint. There were no significant interactions between factors.

DISCUSSION & CONCLUSIONS
DePuy recommends the use of an eccentric glenosphere to improve stability and increase impingement-free range of motion, but does not make recommendations for glenosphere size as it relates to stability [3]. A previous study [4] found that when the dislocation force is applied directly to the head of the humerus, an eccentric glenosphere improves stability but glenosphere size does not significantly affect force to dislocate. The current results suggest that glenosphere size is a significant factor in dislocations caused by impingement.

Interestingly, humeral cup depth did not have a significant effect on force to dislocate by impingement, despite the fact that the retentive cup is designed to increase stability of the joint. Selection of RSA components including an eccentric, large-diameter glenosphere may be effective in improving joint stability, particularly while the arm is adducted.

REFERENCES