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Loss of Anterior Stability of Shoulder Across a Range of Motion Due to Combined Bony Defects: A Cadaveric Study

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Summary:
his study proposes a clinically relevant model that defines the threshold for combined defects that cause significant loss of stability and, it provides insight into the difference in translational instability caused by a glenoid defect versus the rotational instability caused by a humeral head defect.

Abstract:
Previous studies have analyzed only the effects of isolated glenoid or humeral head defects at limited arm positions. Literature data also suggests that instability might vary for envelop of motion. The aim of this study was to evaluate the effect of combined bony lesions on shoulder instability through varying glenohumeral positions. We hypothesized that the shoulder stability would significantly decrease with increasing defect size, and in the presence of combined defects. Furthermore, instability secondary to a humeral head defect will be magnified at functional arm positions.

All experiments were performed at glenohumeral abduction angles (ABD) of 20°, 40°, and 60° and external rotations (ER) of 0°, 40°, and 80° for 18 specimens. Each experiment comprised of translating the glenoid in a posterior direction in order to cause an anterior dislocation under a 50N load. Translational distance of the glenoid and medial-lateral displacement of the humeral head, along with horizontal reaction force were recorded for every trial. Since it was not possible to test every defect combination in a single specimen, three different pathways were chosen (4 levels of glenoid defect and 5 levels of humeral defect) to maximize defect combinations. The sizes of humeral head lesions and glenoid defect were chosen similar to previous studies.

At 60° ABD and 80° ER, stability decreased from 100% to 85.2% and 73.7 % with isolated glenoid defect sizes of 10% and 20%, respectively. A combination of a 44% humeral head defect with 20% and 30% glenoid defect resulted in 1.6% and 1.4% intact translation, respectively. At 20° ABD and 0° ER, % intact translations were 69.0 ± 9.7, 64.3 ±12.9, 64.9 ± 11.1, 66.7 ± 8.8, 69.3 ± 13.9 for humeral defect sizes of 0%, 6%, 19%, 31%, 44% with a 20% glenoid defect, respectively. However, at a functional position of 60° ABD and 80° ER these values were significantly different ($p < 0.05$) for humeral head defects of size 19%, 31%, and 44% with translation values of 48.6 ± 24.2, 26.6 ± 25.2, and 1.6 ± 3.6, respectively. The % intact translation values for glenoid defects sizes 20% and 30% were significantly different ($p < 0.05$) for all arm positions. Combination of a smaller 6% humeral defect with increasing glenoid defects of size 0%, 10%, 20% and 30% has translation values 103.0 ± 2.9, 82.6 ± 16.4, 65.2 ± 12.9, and 40 ± 20.7, respectively. These values were similar at different arm positions.

This study demonstrated that a smaller glenoid defect size of 10% combined with a 19% humeral head defect, can lead to a significant instability. Additionally, it was shown that a significant glenoid defect would lead to loss of translation independent of changes in the arm position. However, the loss of stability from a humeral head defect

would lead to loss of translational stability significantly at a functional arm position of increased abduction and external rotation rather than a resting arm position. This rotational dependency of a humeral head defect further leads to a magnified instability during combined defects.