Effect of Bankart Lesion Combined with Rotator Cuff Tear on Glenohumeral Stability: A Biomechanical Study

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Introduction: Rotator cuff tear combined with Bankart lesion is a common finding in elderly patients after anterior shoulder dislocation. Although the prevalence of traumatic anterior shoulder dislocation in the elderly has tended to increase because of lifestyle changes, active sports participation and prolonged life expectancy, no consensus has been made concerning whether both pathologies should be repaired and the biomechanical effect of rotator cuff tear combined with Bankart lesion has not been evaluated. The purpose of this study was to quantify the biomechanical effect of rotator cuff tear combined with Bankart lesion and the effectiveness of sequential repair of the rotator cuff tear and the Bankart lesion. We hypothesized that a medium sized rotator cuff tear would demonstrate abnormal glenohumeral biomechanics which can induce instability when accompanied with anterior capsulolabral lesion and that repair of both the rotator cuff tear and Bankart lesion is necessary to restore abnormal biomechanics.

Materials and Methods: Eight fresh-frozen cadaveric shoulders were used. All soft tissues were removed except the insertion of the rotator cuff muscles and glenohumeral joint capsule. The specimens were tested on a custom testing system with simulated muscle loading based on the physiological cross-sectional area ratios (Figure 1). Five conditions were tested in each specimen: intact, supraspinatus tendon full-thickness tear, supraspinatus tendon full-thickness tear combined with Bankart lesion, supraspinatus tendon repair and finally a Bankart repair combined with supraspinatus tendon repair. Rotator cuff repair was performed using transosseous equivalent technique and Bankart repair was performed using 3 suture anchors under arthroscopic view. Rotational range of motion and humeral head apex were measured in the scapular plane at 30° and 60° shoulder abduction with simulated muscle loading. The rotational range of motion was measured with 1.1 Nm of torque. The position of the humeral head apex with respect to the glenoid was calculated using a MicroScribe 3DLX at each position from maximum internal to maximum external rotation in 30° increments. The anterior-inferior force required for dislocation was measured at 30°, 60° and 90° of glenohumeral abduction and 90° of external rotation. A repeated-measures ANOVA with a Tukey post hoc test was used for statistical analysis.

Results: Bankart lesion combined with supraspinatus tear significantly increased rotational range of motion at 30° and 60° of glenohumeral abduction (7.6 ± 6.3° increase at 30° abduction and 14.1 ± 10.3° at 60° abduction (p<0.05)). There were no significant effects on glenohumeral kinematics with isolated supraspinatus tear or Bankart lesion combined with supraspinatus tear. Force prior to dislocation per degree of rotation was not significantly different between Bankart lesion combined with supraspinatus tear and intact at 30° abduction and 30° of external rotation (Figure 2). Force prior to dislocation per degree of rotation was significantly less with Bankart lesion combined with supraspinatus tear compared to intact at 60° abduction and 90° of external rotation (16.7 ± 23.7° decrease (p<0.05)) (Figure 3). Supraspinatus repair alone did not restore range of motion or force prior to dislocation. Bankart repair combined with supraspinatus repair shifted the humeral head posteriorly compared to all conditions at the mid-range of rotation in 30° and 60° abduction (p<0.05).

Discussion: The pathophysiology of anterior shoulder dislocation is known to differ in the young and elderly because of tissue elasticity. In the young, dislocation occurs through anterior supporting structures such as the anterior capsulolabral complex, while it occurs through disruption of the posterior supporting structures, particularly the rotator cuff which is the weakest part of the shoulder joint in the elderly. This biomechanical analysis was designed to simulate shoulder dislocation in elderly patients which is frequently associated with both rotator cuff tear and anterior labral lesion. In this biomechanical test, a supraspinatus tear had minimal effect in glenohumeral translation stability, however, when combined with a Bankart lesion, translational forces decreased and rotational range of motion increased. The repair of both rotator cuff tear and Bankart lesion are necessary to restore the increased total rotational range of motion and decreased force prior to dislocation. Abnormal kinematics following Bankart repair combined with supraspinatus repair may be due to over-tightening the glenohumeral joint in this model.

Significance: Both rotator cuff and anterior labral repair are suggested for patients with combined Bankart lesions and rotator cuff tear to restore shoulder function and prevent recurrent dislocation. However, when repairing both pathologies, care should be taken not to over-tighten the joint which may lead to stiffness or osteoarthritis.


References: