Posterior Shoulder Stability can be Restored by Posterior Acromial Bone Grafting in a Cadaveric Biomechanical Model with Acromial Malalignment but Normal Glenoid Anatomy

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INTRODUCTION:

A high and flat acromion seems to be a risk factor for posterior shoulder instability. Biomechanically, surgical correction of acromial malalignment can restore glenohumeral joint stability. In 1973, Scapinelli proposed bone grafting of the posterolateral acromion, with an autograft taken from the scapular spine and obtained excellent clinical results without recurrence of instability in ten patients with a mean follow-up of 9.6 years.

The purpose of this study was to assess (1) the stabilizing effect of a posterior acromial bone graft (PABG) in moderate and severe acromial malalignment (high and flat) and (2) contact patterns under posterior humeral head displacement. The hypotheses of this study were that a PABG significantly (1) increases resistance to posterior humeral head displacement, (2) restores stability and (3) acromiohumeral contact pressure.

METHODS:

Eight fresh-frozen human cadaveric shoulders, with normal glenoid anatomy, were tested in a shoulder simulator in load-and-shift and Jerk test positions. Each specimen underwent five testing conditions using 3D printed cutting and reduction guides, the joint was left intact for each condition: (1) *Severe* acromial malalignment; (2) Severe acromial malalignment +PABG; (3) *Moderate* acromial malalignment; (4) Moderate acromial malalignment +PABG; (5) *Corrected* acromial alignment. The humeral head was translated posteriorly until reaching either a peak force of 150N or maximum posterior displacement of 50% of glenoid width. Forces, displacement and acromiohumeral contact pressures were recorded.

RESULTS:

In 30° of flexion, the force needed to displace the humeral head 50% increased by 659% when a PABG was added to a moderately malaligned acromion and by 1249% for a severely malaligned acromion. In 60° of flexion, it increased by 293% and 348%. This stabilizing effect increased progressively with increasing displacement ($p<0.05$ for all comparisons after ≥5% displacement). Compared to acromial correction, PABG allowed comparable posterior displacement, but required different amounts of force depending on the scenario. In 30° of flexion after 30% of displacement PABG provided significantly greater stability ($p<0.05$ for all comparisons). Mean contact pressure was significantly reduced on the rotator cuff and significantly increased on the acromial undersurface in acromial pathology, whereas PABG restored acromiohumeral contact pressures comparable to corrective osteotomy, particularly at 30º flexion.

DISCUSSION AND CONCLUSION:

The most important finding of this study is that posterior acromial bone grafting significantly increases resistance to posterior humeral head displacement in shoulders with acromial malalignment and normal glenoid position and orientation. At both 30° and 60° of glenohumeral flexion, the addition of a PABG to either moderately or severely malaligned acromions enhanced stability after as little as 5% of posterior humeral head displacement, with this stabilizing effect increasing progressively with greater displacement. This finding provides biomechanical evidence supporting Scapinelli's 1973 approach.

Another key finding of this study is that PABG provided comparable or superior stability to formal acromial correction, depending on the testing position and degree of displacement. At 30° flexion, PABG and acromial correction offered similar stability up to 30% of displacement, beyond which PABG actually provided significantly greater resistance. At a theoretical 50% displacement point, it would require substantially higher forces to dislocate a PABG-augmented shoulder compared to one with corrected acromial alignment. This finding has significant clinical implications, as it suggests that PABG—a technically simpler procedure than three-dimensional corrective osteotomy—may achieve at worst, equivalent, and at best, superior biomechanical stability.