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Tensioning of the Superior Capsule Reconstruction Graft Improves Shoulder Function Biomechanically

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Summary:

The superior capsule reconstruction shows significant better results when the graft is fixed under tension compared to a non-tensioned graft simulating a spacer.

Abstract:

Purpose

Biomechanically it has been shown that the superior capsule represents an important static stabilizer against superior head migration in the glenohumeral joint and its reconstruction improves humeral head centration. A remaining open question is the amount of graft tension needed for the superior capsule reconstruction (SCR) to perform best. Purpose of the study therefore was to investigate how does graft tension influence shoulder function on a dynamic abduction motion. It was hypothesized that proper graft tension is needed and would ensure a better performance biomechanically than a non-tensioned graft interposition.

Methods

Ten fresh-frozen cadaveric shoulders were utilized. The anterior, middle, and posterior deltoid tendons and rotator cuff tendons were attached to individual shoulder simulator actuators. Deltoid pulleys were spread over the lateral edge of the acromion according to the native force vectors. Cuff pulleys were loaded in the direction of the musculotendinous unit. Optical tracking tripods on the lateral distal humerus (moving) and the lateral acromion (fixed) tracked 3D motion during dynamic testing. Mean values for maximum glenohumeral abduction and deltoid forces were recorded among 4 conditions: (1) intact shoulder, (2) simulated irreparable supraspinatus (SSP) tear, (3) superior capsule reconstruction using a commercially available 3-mm thick acellular dermal allograft put into place without further tensioning it (0-5N graft tension) simulating a spacer, and (4) superior capsule reconstruction using the same graft but pre-tensioning and fixing it with 30-35(N).

Results

Intact shoulders required $193.2 \text{ N} \pm 45.1$ total deltoid force to achieve $79.8^\circ \pm 5.8$ maximum glenohumeral abduction. Compared to native shoulders, abduction decreased following SSP tears (27.5%, to an average of $54.3^\circ \pm 13.7$ $p=0.04$), cuff, while total deltoid forces increased by (23.4%, to an average of $252.1 \text{ N} \pm 68.3$ $p=0.04$). The non-tensioned SCR did not improve shoulder function (abd. $54.1^\circ \pm 16.1$) or acquired deltoid force ($277.8 \text{ N} \pm 39.8$) compared to the SSP tear status. However, a tensioned SCR reconstruction improved shoulder function reaching an average abduction angle of $65.1^\circ \pm 12.5$. Therefore, displaying a significant improvement compared to the SSP tear

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($p=0.04$) but still remain reduced compared to the native state ($p=0.01$), without reducing combined deltoid force $282.3\text{N} \pm 47.9$).

Conclusion

The superior capsule reconstruction shows significant better results when the graft is fixed under tension compared to a non-tensioned graft simulating a spacer. Therefore, correct graft measurement and adequate tension, at least 30 N, are important aspect for the surgical procedure.