Biomechanical Assessment of Anterior Stability and Glenoid Concavity Restoration Between Distal Tibial Allograft Reconstruction and the Latarjet Procedure

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INTRODUCTION: Glenoid bone loss occurs in more than 80% of patients with recurrent glenohumeral instability. The Latarjet procedure has become the gold standard for restoration of bone loss despite a high (15-30%) complication rate.[1] Distal tibial allograft (DTA) reconstruction has recently gained interest due to its ability to restore width and concavity to the glenoid while providing a cartilage surface.[2] The purpose of this study is to evaluate whether DTA can restore glenohumeral anterior stability and the glenoid concavity, and compare it against the Latarjet procedure.

METHODS: Nine human cadaveric specimens (mean age: 62.2, range 57-69; 87.5% male) underwent preoperative computed tomography (CT) scans to assess the glenoid depth and radius and define the shoulder stability ratio (BSSR–glenoid depth over glenoid radius). To test glenohumeral stability a custom cadaveric shoulder simulator that allows 6 degrees of freedom at the glenohumeral joint was used. The specimens were placed with the scapula at 30° upward rotation and humerus at 60° glenohumeral abduction. A constant compressive force was created by loading the supraspinatus, infraspinatus teres minor and subscapularis muscles with loads (2lbs, 3lbs, 1lbs and 4lbs respectively). An anterior glenohumeral force was progressively applied (rate of pull 1mm/sec) and up to 40N through the pectoralis tendon and with the humerus at neutral rotation. A camera motion system was used to measure the gleno-humeral translations.
To create the Latarjet and DTA, first the coracoid was harvested, and the thickness was measured. A distal tibial allograft was also contoured to an identical size. A glenoid defect was created to match the thickness of the graft since both Latarjet and DTA aimed for a 100% glenoid restoration. The following conditions were tested: 1. intact, 2. Bankart lesion, 3. DTA reconstruction, 4. Latarjet without the conjoint tendon loaded ('Latarjet no Sling'), and 5. Latarjet with conjoint tendon loaded 2lbs ('Latarjet Sling''). All specimens were CT scanned after testing and BSSR was measured for both DTA and Latarjet reconstructions. A repeated measures ANOVA with post-hoc Bonferroni was performed to determine significant differences in maximum anterior translation between all conditions and a student t-test was used to determine the significance in BSSR between the DTA reconstruction and Latarjet procedure.

RESULTS SECTION: DTA reconstructed the glenoid with a significantly greater concavity than the Latarjet procedure (BSSR: 0.43±1.5mm vs 0.32±1.1mm, p = 0.001). The maximum glenohumeral anterior translation was significantly lower after the DTA than the Latarjet without the sling (4.8±3.4mm vs 10.5±3.2mm, p = 0.043). However, there was no difference in anterior translation between the DTA reconstruction and Latarjet Sling (4.8±3.4mm mm vs 4.7±4.3mm).

DISCUSSION: When addressing bone loss in glenohumeral instability, additional factors besides the restoration of glenoid width contribute to stability. The more concave reconstruction produced by the distal tibial allograft decreases anterior translation compared to the bony reconstruction produced by the Latarjet. However, when Latarjet was used with tension on the conjoint tension (sling effect) the anterior translation was similar to DTA, the results suggested that from biomechanical point of view, the DTA reconstruction could be used as an alternative procedure to the Latarjet.

SIGNIFICANCE/CLINICAL RELEVANCE: The DTA can be used as an alternative to Latarjet procedure since it has shown that can better restore glenoid cavity and demonstrated similar biomechanical benefits on restoring anterior glenohumeral instability on patients with glenoid bone loss.

REFERENCES: 1) Cho CH et al. Complications Related to Latarjet Shoulder Stabilization: A Systematic Review. AJSM. 2021. 2) Provencher MT, et al. Anatomic osteochondral glenoid reconstruction for recurrent glenohumeral instability with glenoid deficiency using a distal tibia allograft. Arthroscopy. 2009.

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Figure 1: Glenoid Curvature Comparison Latarjet Vs DTA

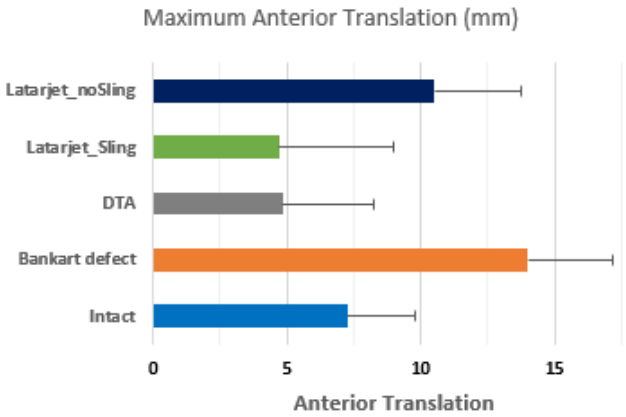

Figure 2: Maximum anterior humeral translations following the application of anterior force.