Functional Biomechanical Comparison of Latarjet versus Distal Tibial Osteochondral Allograft for Anterior Glenoid Defect Reconstruction

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INTRODUCTION:

Glenoid reconstruction is indicated for recurrent glenohumeral instability with significant glenoid bone deficiency. Coracoid autograft (Latarjet) and distal tibial osteochondral allograft (DTA) reconstructions have been used to successfully restore glenohumeral stability. Benefits associated with Latarjet include the integration, availability, and cost advantages for use of autogenous tissue. Potential disadvantages include the morbidity of tissue harvest, the lack of articular cartilage restoration, and the nonanatomic geometry of the graft. To address the disadvantages associated with Latarjet glenoid reconstruction, DTA transplantation has been used to successfully treat glenoid bone deficiency. The distal tibial articular cartilage surface closely matches the geometry of the native glenoid and avoids donor site morbidity. However, direct comparisons of functional glenohumeral biomechanics associated with Latarjet versus DTA reconstruction are lacking. This study was designed to compare these two glenoid reconstruction techniques with respect to joint kinematics and cartilage loading properties using a robotic testing system.

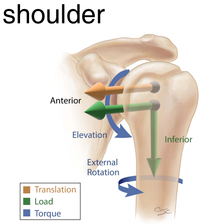
METHODS:

In accordance with institutional review board policies, human cadaveric shoulders (n=8) were tested under a 45N joint-compression load in three positions (Neutral, 60 degrees abduction from 0-90 degrees external rotation, and 90 degrees abduction from 0-90 degrees external rotation) to determine center of rotation, humeral head translation (mm), load (N), and torque (Nm) using a six-degree-of-freedom robotic testing system. Cyclic testing was then performed in two stages: 1) 60 degrees of abduction with rotation to 90 degrees of external rotation and 2) 90 degrees of abduction with rotation to 90 degrees of external rotation. Each cycle started and ended with the glenohumeral joint in the neutral position, and each stage consisted of 10 cycles. Neutral and maximal values for translation, load, and torque in each of the three positions were measured and recorded. Following cyclic testing, contact areas and pressures were assessed under a 120N joint-compression load using pressure mapping sensors. After confirming that a 25% anterior glenoid defect resulted in glenohumeral dislocation, testing was performed to compare 3 conditions: Native intact glenoid, 25% anterior glenoid defect with Latarjet reconstruction, and 25% anterior glenoid defect with DTA reconstruction. ANOVA and t-Tests were used to analyze data with statistical significance set at p<0.05.

RESULTS: When cyclically tested in 60 degrees of abduction, there was significantly less anterior translation (p = 0.015), inferior drawer load (p=0.001), anterior drawer load (p=0.0039), negative elevation torque (p=0.031), and external rotation torque (p=0.013) when comparing the two different glenoid bone reconstruction techniques to native shoulders. The only significant difference between Latarjet and DTA reconstructions for measured translations, loads, and torques was a significantly higher absolute maximum compressive load for Latarjet compared to DTA at 60 degrees of abduction (p=0.008). When tested at 90 degrees of abduction, there was significantly less inferior drawer load (p<0.0001), anterior drawer load (p=0.0006), negative elevation torque (p=0.0052), external rotation torque (p=0.013), and horizontal abduction torque (p=0.015) for both reconstructions compared to the native status.

DISCUSSION AND CONCLUSION:

Latarjet coracoid osseous autograft and distal tibial osteochondral allograft reconstructions of large (25%) glenoid bone defects are associated with significant glenohumeral kinematic differences that largely confer less translation, load, and torque on the joint in abduction when compared to the native state. These findings suggest that these two surgical techniques exhibit similar glenohumeral kinematics such that each provides adequate functional stability following anterior glenoid bone reconstruction. Joint compression load and articular contact area and pressure parameters may favor distal tibial osteochondral allograft reconstruction for treatment of large (25%) anterior glenoid bone defects associated with shoulder instability.



60° abduction					
DOF	ΔAnterior Change (mm)	ΔInferior Drawer Load (N)	ΔAnterior Drawer Load (N)	ΔNegative Elevation Torque (Nm)	ΔExternal Rotation Torque (Nm)
Native	5.4 ± 2.8	19.2 ± 7.3	25.4 ± 7.5	0.79 ± 0.45	4.5 ± 3.8
Latarjet	3.1 ± 1.6	4.1 ± 1.3	7.6 ± 3.8	0.37 ± 0.26	1.9 ± 1.4
DTA	2.4 ± 0.8	4.6 ± 1.8	4.3 ± 1.3	0.24 ± 0.1	2.2 ± 1.4
p-value	**0.015**	**0.001**	**0.0039**	**0.031**	**0.013**

90° abduction					
DOF	ΔInferior Drawer Load (N)	ΔAnterior Drawer Load (N)	ΔHorizontal Abduction Torque (Nm)	ΔNegative Elevation Torque (Nm)	ΔExternal Rotation Torque (Nm)
Native	20.2 ± 8.4	19.7 ± 8.8	2.8 ± 1.7	2.7 ± 1.4	6.6 ± 2
Latarjet	7.1 ± 4	6.1 ± 2.4	0.98 ± 1.1	1.2 ± 0.9	2.3 ± 1.7
DTA	5.7 ± 3.7	4.5 ± 2.2	1.6 ± 1.2	0.89 ± 0.5	1.5 ± 1.1
p-value	**<0.0001**	**0.0006**	**0.015**	**0.0052**	**0.013**

Status	Native	Latarjet	DTA	P-value
Compression Max (N) @ 60º	26.9 ± 5.2	35.6 ± 4.1	29.2 ± 4.6	**0.008**
Compression Max (N) @ 90º	31.9 ± 12.3	43.9 ± 4.9	36.3 ± 8.9	0.19