Distal Radius Allograft for Glenohumeral Instability: A Novel Osteochondral Allograft Reconstruction Option in the Setting of Glenoid Bone Loss

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INTRODUCTION: Glenoid bone loss in the setting of recurrent shoulder instability remains a challenging surgical problem. The coracoid process and iliac crest currently serve as primary autograft options for glenoid reconstruction. With regard to allograft alternatives, the distal tibia, first described in 2007, has good mid-term outcomes when used during an index surgery and in cases of failed prior Latarjet reconstruction. While the distal tibia performs well in reconstructing the glenoid bony defect, it is a nonanatomic reconstruction and does not match the glenoid radius of curvature (ROC) in the anterior to posterior (AP) plane. No prior work has evaluated and described the utilization of the dorsal articular portion of the distal radius as an allograft reconstruction option for recurrent instability with glenoid bony deficiency. The purpose of this study was to evaluate distal radius fresh frozen allograft as a potential match for glenoid reconstruction through assessment of graft ROC and bone mineral density (BMD). Distal tibia allograft was utilized as the primary comparison group with both cadaveric and Computerized Tomography (CT) analysis.

METHODS: Eighteen fresh-frozen human cadaveric specimens (6 shoulder, 6 wrist, and 6 tibia) were utilized for this study. Specimens without osteoarthritis or prior surgical procedures were included. CT scans were obtained of all specimens to confirm the absence of osteoarthritis, significant joint deformity, or evidence of prior surgical procedure. Specimens were dissected free of all soft tissues except for the glenoid labrum of the shoulder and dorsal wrist ligaments of the distal radius. The ROC for each specimen were independently measured by two fellowship trained shoulder surgeons in both the superior to inferior (SI) and AP planes. Graft length in the SI plane was also assessed. A thirty percent defect was then created in all glenoid specimens and both distal tibia and distal radius grafts were harvested to assess graft fit post-fixation [**Figure 1**]. CTs were also analyzed to assess bony ROC and BMD for each specimen.

RESULTS: On cadaveric analysis, the mean SI graft length of the glenoid was 39.7 mm compared to 36.8 mm for the distal radius, and 30.0 mm for the distal tibia [**Table 1A**]. Average ROC in the SI plane was 29.0 +/- 5.3 for the glenoid, 37.8 +/- 4.9 for the distal radius, and 24.0 +/- 3.7 for the distal tibia; in the AP plan average ROC was 39.6 +/- 6.6 for the glenoid, 30.4 +/- 18.6 for the distal radius, and 126.3 +/- 9.5 for the distal tibia [**Table 1B**]. On CT analysis, average ROC in the SI plane was 30.4 +/- 1.5 for the glenoid, 30.3 +/- 5.6 for the distal radius, and 24.5 +/- 9.4 for the distal tibia; in the AP plane average ROC was 30.8 +/- 2.0 for the glenoid, 19.1 +/- 2.3 for the distal radius, and 46.7 +/- 21.7 for the distal tibia [**Table 2A**]. Mean BMD was 226.3 +/- 79.0 for the glenoid, 228.5 +/-94.7 for the distal radius, 235.0 +/- 96.2 for the coracoid process, and 235.1 +/- 84.6 for the distal tibia [**Table 2B**].

DISCUSSION AND CONCLUSION: Given fresh frozen allograft supply and cost constraints, exploration of additional graft options is necessitated. This study presents distal radius allograft as a novel reconstruction option for patients with anterior glenoid bone loss in the setting of recurrent glenohumeral instability. Compared with the distal tibia allograft, the distal radius had greater graft length in the SI plane providing possible utilization in cases of larger bony defects. The distal radius also has a more acute ROC in the AP plane (closer to that of the glenoid) compared with the distal tibia allograft providing a greater potential buttress to anterior humeral translation. Furthermore, the distal radius also has potential to employ the dorsal radio-carpal ligaments to perform an anterior capsular repair following allograft fixation. Finally, compared to currently utilized grafts (coracoid process and distal tibia), the distal radius BMD was not significantly diminished on CT analysis. This study presents the distal radius as a novel allograft reconstruction option in the setting of glenoid bone loss; further biomechanical and clinical investigation is indicated.

Figure 1. The 30% glenoid defect created for each sample is demonstrated in (A). After the distal radius or distal tibial allograft was harvested, it was fixed to the glenoid with two cannulated screws. The distal radius allograft is demonstrated in the SI plane (B) and AP plane (C). The distal tibia allograft is demonstrated in the SI plane (D) and AP plane (E). The arrow in image (C) denotes the more acute radius of curvature of the dorsal distal radius in the AP plane.

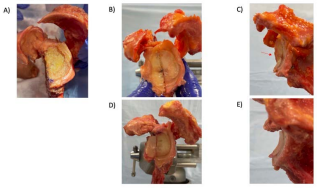

Table 1. Mean cadaveric measurements of specimen length (A) and radius of curvature (B). Specimen length and radius of curvature were measured in millimeters (mm).

A)

	Specimen Length (mm) Superior to Inferior	
	Mean	SD
Glenoid	39.7	5.7
Distal Radius	36.8	3.2
Distal Tibia	30.0	3.3

B)

	Cadaveric Radius of Curvature Mean (SD)	
	Superior to Inferior	Anterior to Posterior
Glenoid	29.0 (5.3)	39.6 (6.6)
Distal Radius	37.8 (4.9)	30.4 (18.6)
Distal Tibia	24.0 (3.7)	126.3 (9.5)

Table 2. Mean CT measurements of radius of curvature (A) and bone mineral density (B). Radius of curvature is measured in millimeters (mm). Bone mineral density is measures in Hounsfield Units (HU).

A)

	CT Radius of Curvature Mean (SD)	
	Superior to Inferior	Anterior to Posterior
Glenoid	30.4 (1.5)	30.8 (2.0)
Distal Radius	30.3 (5.6)	19.1 (2.3)
Distal Tibia	24.5 (9.4)	46.7 (21.7)

B)

	Bone Mineral Density (HU)	
	Mean	SD
Glenoid	226.3	79.0
Distal Radius	228.5	94.7
Coracoid Process	235.0	96.2
Distal Tibia	235.1	84.6