TITLE: Outcomes of Revision Total Elbow Arthroplasty with Bone Loss with Allograft-Prosthetic Composite, Strut Allograft, or Megaprosthesis

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INTRODUCTION: Management of catastrophic bone loss in revision total elbow arthroplasty (TEA) remains challenging. Augmentation options for severe bone loss include cortical strut allografts, allograft-prosthetic composites (APC), or megaprostheses. The literature is sparse on the outcomes of revision TEA constructs in the setting of significant bone loss.[1] This study aims to describe the survivorship and clinical outcomes of revision TEA with strut allograft, APC, or megaprosthesis.

METHODS: This was a single-institution retrospective descriptive study of all revision TEA with strut allograft, APC, or megaprosthesis reconstruction between 2011 and 2023. Patients were excluded if their surgery was performed in the primary setting. Total humerus replacements were excluded. Number of previous surgeries and indication for surgery were collected from chart review. The primary outcomes were revision-free implant survivorship and patient satisfaction. Secondary outcomes included quickDASH scores and VAS pain scores. Kaplan-Meier survival curves were generated for each cohort. We opted against comparison testing between reconstructive options as the bone defects that are treated with strut allografts, APCs, and megaprostheses are all markedly different.

RESULTS: A total of 40 revision TEA constructs were included (16 with strut allograft in 14 patients, 10 with ulnar APC in 8 patients, and 14 with humeral megaprostheses in 13 patients). The mean number of prior ipsilateral elbow surgeries for these groups and indications for primary and revision TEA are listed in Table 1.

Revision-free survivorship of strut allografts was 50% (8/16) at mean 4.7 years. The eight revision surgeries occurred at average 13.0 months (range 1.4-39.3) postoperatively (Figure 1, Table 1). Within this cohort, there were 8 humeral strut allografts and 8 ulnar strut allografts. Three of the 4 failures in the humeral strut allograft cohort were due to infection and 3 of the 4 failures in the ulnar strut allograft cohort were due to aseptic loosening. In patients with unrevised strut allografts, mean quickDASH and VAS pain scores were 44.1 and 2.6, respectively. 56% of all patients reported satisfaction with the outcomes of their revision TEA with strut allograft.

Revision-free survivorship of ulnar APCs was 50% (5/10) at mean 4.9 years. In those who were revised, mean time to failure was 7.7 months (range 1-19 months) (Figure 1, Table 1). In patients with an unrevised ulnar APC, mean quickDASH and VAS pain score were 39.4 and 1.7, respectively. 50% of all patients reported satisfaction with their ulnar APC surgery.

Revision-free survivorship of megaprostheses was 50% (7/14) at 2.8 years. In those who were revised, mean time to failure of 9.6 months (range 1.1-18.9) (Figure 1, Table 1). Despite the 21% revision rate for aseptic loosening (Table 1), 4 of 7 (57%) unrevised patients had signs of radiographic loosening at the most recent encounter. In patients with unrevised revision TEA with humeral megaprosthesis, mean quickDASH and VAS pain score were 50.0 and 2.3, respectively. 44% of all patients reported satisfaction with the outcomes of their revision TEA with humeral megaprosthetic.

DISCUSSION: Revision TEA in the setting of either humeral or ulnar bone loss is a challenging problem for both surgeons and patients. This study suggests that regardless of the treatment method, there is a high revision rate with the likelihood that the patient will go on to have multiple surgeries afterwards. Patients should be counseled extensively on the prognosis of these implants and shared decision making should be prioritized to ensure that the patient's goals are aligned with the expected outcomes of these surgeries.

REFERENCES:

1. Morrey ME, Sanchez-Sotelo J, Abdel MP, Morrey BF. Allograft-Prosthetic Composite Reconstruction for Massive Bone Loss Including Catastrophic Failure in Total Elbow Arthroplasty: *The Journal of Bone and Joint Surgery-American Volume*. 2013;95(12):1117-1124. doi:10.2106/JBJS.L.00747

Table 1. Characteristics of patients undergoing revision TEA with strut allograft, ulnar APC, or humeral megaprosthetic.

	Strut Allograft N=16	Ulnar APC N=10	Humeral Megaprosthetic N=14
Age (Years)	58.6 ± 13.6	64.3 ± 9.4	62.0 ± 7.4
Follow-up (Months)	56.5 ± 45.6	58.7 ± 50.2	41.6 ± 33.9
	6-156	6-139	6-113
Prior Surgeries	3.5 ± 2.8	5.3 ± 3.2	4.1 ± 3.0
Range	1-13	1-12	1-12
Dominant Arm	12 (80)	6 (60)	9 (64)
Primary TEA Indication			
RA	7 (44)	6 (60)	3 (21)
PTA	7 (44)	4 (40)	9 (64)
Acute Fracture	2 (13)	0 (0)	2 (14)
Revision TEA Indication			
Infection	4 (25)	1 (10)	4 (29)
Aseptic Loosening	5 (31)	5 (50)	3 (21)
Periprosthetic Fracture	5 (31)	4 (40)	6 (43)
Hardware Failure	2 (13)	0 (0)	1 (7)
Failures	8 (50)	5 (50)	7 (50)
Mean Time to Failure (Months)	13.0 ± 13.6	7.7 ± 6.7	9.6 ± 7.7
Range	1-39	1-19	1-19
Mode of Failure			
Infection	3 (19)	1 (10)	3 (21)
Aseptic Loosening	3 (19)	3 (30)	4 (29)
Periprosthetic Fracture	2 (13)	1 (10)	0 (0)
Number of Subsequent Surgeries	1.8 ± 0.7	1.4 ± 1.1	1.8 ± 1.4
Eventual Resection Arthroplasty	5 (31)	2 (20)	3 (21)

TEA: total elbow arthroplasty, RA: rheumatoid arthritis, PTA: post-traumatic arthritis

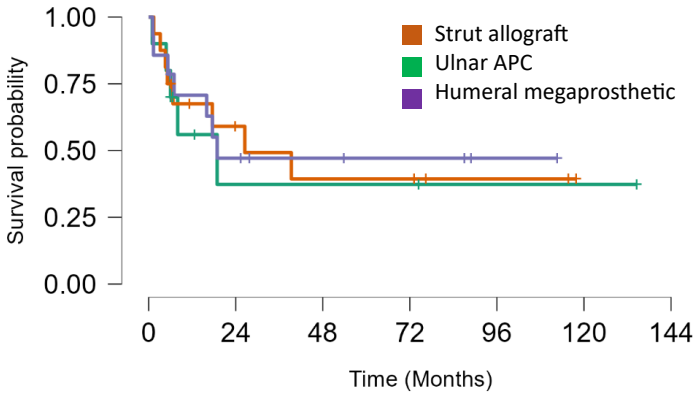

Figure 1. Kaplan-Meier survival curve for revision TEA with strut allograft, ulnar APC, or humeral megaprosthetic. Tick marks represent censored patients.