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Outcomes of anconeus interposition for proximal radioulnar synostosis

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Background/Hypothesis: Proximal radioulnar synostosis after elbow injuries can produce debilitating contractures. The estimated range of motion required to perform many activities of daily living is a 100° arc of forearm rotation. We hypothesized that excision of heterotopic bone and anconeus flap interposition could restore functional prono-supination in patients with proximal radioulnar synostosis.

Methods: Patients with proximal radioulnar synostosis were subdivided into 2 groups on the basis of etiology: (1) as a complication after distal biceps tendon repair or (2) as a result of direct trauma to the proximal forearm/elbow. All patients underwent an excision of the synostosis with interposition of an anconeus flap and were observed clinically for a minimum of 6 months.

Results: Twenty-three patients (16 men, 7 women) were included, with a mean age of 47 years and mean clinical follow-up of 4.8 years. Mean arc of forearm rotation improved from 21° to 132°, pronation increased from 12° to 70°, and supination increased from 9° to 62° ($P < .0001$). Patients with biceps tendon repair etiology (n = 7) displayed greater gains in pronation and a trend toward greater total forearm rotation than did those with a traumatic etiology (n = 16).

Conclusion: Anconeus interposition flap for management of proximal radioulnar synostosis produces significant and reliable clinical improvement in elbow prono-supination. Patients with biceps tendon repair etiology had a trend toward greater motion improvement than that of patients with a traumatic etiology. The degree of improvement seen would provide nearly full restoration of functional motion, resulting in minimal limitations in activities of daily living.

Level of evidence: Level III.

Keywords: Proximal radioulnar synostosis; anconeus interposition; elbow trauma

Heterotopic bone formation after elbow injuries has been well recognized.[19] More recently, various studies have documented the debilitating loss of prono-supination that can result from proximal radioulnar synostosis and the improvements that can be obtained by operative management.[1-3,5,6,10,16,18,20]

The arc of motion required at the elbow for activities of daily living has been extensively studied.[4,8,9,13-15] The motion required for normal tasks is often cited as 30° to 130° of flexion, with 50° of both pronation and supination.[9] However, more recent studies assessing modern tasks with the increased accuracy of 3-dimensional motion tracking

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systems have found that only 50° of pronation and supination would still result in several limitations.[4,8,13-15] All patients in this series were frustrated with their decreased mobility and sought remedy.

The anconeus interposition flap as an adjunct after excision of bone and scar that is restricting motion has been reported and has shown promise in restoring motion after these injuries.[1,10,16] We hypothesized that excision of heterotopic bone and anconeus flap interposition could restore and maintain functional forearm rotation—a 100° arc of prono-supination—in patients with proximal radioulnar synostosis.

Materials and methods

This is a retrospective comparative study of 29 adult patients with partial or complete proximal radioulnar synostosis who underwent an excision of the synostosis and interposition of an anconeus flap between 1997 and 2011. All patients had presented with complaints of loss of motion of the forearm and difficulty with activities of daily living. The surgeries were performed by 1 of 2 senior elbow surgeons who subsequently performed all follow-up evaluations. An attempt was made to contact all 29 patients to undergo a clinical examination if the patient had less than 6 months of follow-up in the medical record. One patient had died of unrelated causes and 5 patients could not be contacted or refused to participate, leaving 23 patients with an average follow-up of 57 months (range, 6-171 months) (Table I).

Sixteen patients had undergone the procedure for a synostosis related to a previous fracture or a dislocation of the elbow (Fig. 1). They had the following original diagnoses: 8 patients had sustained fracture-dislocations of the elbow, 3 had proximal both-bone forearm fractures, 2 had sustained intra-articular gunshot wounds, 2 had proximal ulna fractures, and 1 patient had both distal humerus and proximal ulna fractures. These patients had undergone an average of 2.8 operative procedures (range, 1-5) before presenting to our facility with complaints of loss of forearm rotation.

The proximal radioulnar synostosis was evaluated before anconeus interposition by the Jupiter and Ring modification[5] of the classification system initially proposed by Vince and Miller.[20] In this system, grade III synostosis involves the proximal third of the forearm and is divided into 3 subgroups. Grade IIIA synostosis is located at or distal to the bicipital tuberosity, IIIB involves the radial head and proximal radioulnar joint, and IIIC describes synostosis that is contiguous with heterotopic bone about the distal humerus. Of the 16 patients in the trauma cohort, 2 had grade IIIA synostosis and 13 had grade IIIB; 1 patient's radiographs were unavailable. Eleven patients had complete synostosis with no forearm rotation at the time of presentation (7 fixed in neutral, 2 in pronation, 2 in supination), whereas 5 patients had incomplete synostosis with some minimal residual motion.

Seven patients had developed a radioulnar synostosis after undergoing a distal biceps tendon repair. All patients had undergone a single procedure for the repair before development of the synostosis. Five patients had a repair through a 2-incision technique, 4 of whom had complete synostosis fixed in a neutral position with no residual motion and 1 of whom had 10° of forearm rotation. One patient had a repair with an endobutton technique and had 90° of supination preoperatively, and 1 patient had a suture anchor fixation technique with 30° of pronation and 20° of supination preoperatively. Six patients had grade IIIA synostosis, and 1 patient's pre-resection radiographs were unavailable.

Table I Demographic data and results comparing trauma and biceps tendon rupture etiology cohorts

	Biceps cohort (range)	Trauma cohort (range)	*P* value
N	7	16	—
Age, years	49 (39-58)	46 (19-68)	.51
Gender (M:F)	5:2	11:5	.82
Laterality (R:L)	4:3	9:7	.87
Follow-up, months	64 (6-148)	54 (6-171)	.67
Previous operations	1.0 (1-1)	2.8 (1-5)	.002
Synostosis class			
Grade IIIA	6	2	
Grade IIIB	0	13	.001
Not available	1	1	
Preoperative motion			
Pronation	9 (0-30)	14 (0-80)	.60
Supination	13 (0-90)	7 (0-70)	.61
Total	21 (0-90)	21 (0-100)	.96
Extension	1 (0-10)	29 (0-70)	—
Flexion	136 (130-140)	118 (70-140)	—
Total	135 (130-140)	89 (0-145)	—
Postoperative motion			
Pronation	84 (60-90)	64 (0-90)	.07
Supination	69 (10-90)	58 (0-90)	.45
Total	153 (80-180)	122 (17-180)	.17
Extension	0 (0-0)	25 (0-70)	—
Flexion	138 (130-140)	122 (70-150)	—
Total	138 (130-140)	97 (0-145)	—
Complications	1	2	—

Surgical technique

Because the location of the heterotopic bone was usually most prominent on the dorsal aspect of the radioulnar surfaces (Fig. 2), the surgical approach included the dorsal limb of anconeus interval, permitting a simultaneous elevation of the myofascial flap based proximally. This allowed later interposition into the very region where there is the least distance between the radius and the ulna, thereby acting as a barrier precluding regrowth of the bridging heterotopic bone.

A proximally based anconeus myofascial flap interposition was used for treatment of radioulnar synostosis in our patients. The anconeus was exposed through a posterior-lateral approach as described by Pankovich.[12] The silhouette of the anconeus was identified, and it was elevated as a full-thickness myofascial flap with use of electrocautery. The flap was raised subperiosteally off of the ulna in a distal to proximal fashion to preserve the proximal vascular supply of the anconeus through the recurrent posterior interosseous artery. The proximal aspect was left intact to the lateral aspect of the olecranon to protect the vascular pedicle, which has been shown to have a mean length of 3.1 cm.[11] The posterior interosseous nerve remains protected anteriorly within