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Anconeus interposition arthroplasty in acute multiligamentous elbow injuries with irreparable radial head fractures: a novel approach

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Objective: The purpose of this study was to evaluate the results of a new reconstruction with anconeus interposition arthroplasty in acute multiligamentous elbow injuries with irreparable radial head fractures.

Methods: Five patients (3 males, 2 females) with a mean age of 42.6 years who underwent reconstruction with anconeus arhtroplasty were evaluated. With lateral approach, lateral capsuloligamentous structures were repaired, the radial head was excised, and anconeus interposition arthroplasty was performed. With medial intervention, the medial collateral ligament was repaired, and the ulnar nerve was transposed anteriorly. Clinical and radiological evaluation was performed the end of a mean follow-up period of 63 months.

Results: Mean Mayo Elbow Performance, Oxford Elbow, and Disabilities of the Arm, Shoulder and Hand (DASH) scores were 91, 41.4, and 13.76, respectively. Average elbow extension loss was 10.2° and average forearm supination loss was 5.2°. Dynamic elbow instability tests were within normal limits. On elbow radiographs, the average increase in cubitus valgus angle was 5.4°. No patient reported limitation in daily activities. There was no heterotopic ossification in any patient. Mean radial shortening was 1.39 mm, and no patient suffered from wrist pain at final follow-up. Average Mayo wrist score was 91 points.

Conclusion: The combination of repair of the medial and lateral structures, radial head resection, and anconeus interposition arthroplasty may be a good alternative in the treatment of acute multiligamentous elbow injuries with irreparable radial head fracture.

Keywords: Anconeus interposition arthroplasty; multiligamentous elbow injury; radial head fracture.

Level of Evidence: Level IV, Therapeutic Study.

The treatment of comminuted radial head fractures in acute elbow fracture dislocations is a challenging problem. Radial head fractures with 3 or more fragments have a high incidence of complications when treated with primary osteosynthesis to achieve an anatomic radial head. [1] Resection of the radial head is known to be ineffective

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if there is a concurrent ligamentous injury.[1,2] Prosthetic replacement is indicated after radial head resection in the presence of an injury of the medial collateral ligament (MCL) or the interosseous membrane.[1] However, achieving radial head anatomy and radiocapitellar joint congruity with radial head prostheses remains difficult. Despite the variety and number of designs, none of the prostheses resemble the anatomy of the proximal radius.[3,4] Therefore, complications such as aseptic loosening, prosthesis dislocation, protrusion, and overstuffing are reported.[4,5] These problems are unresolved at present, but investigations on different prosthetic designs continue.

Morrey and Schneeberger popularized the anconeus interposition arthroplasty technique in the treatment of radiocapitellar and/or proximal radioulnar joint dysfunction and pain after trauma.[2,3] This technique has been used in the treatment of radiocapitellar impingement after resection of the heterotopic ossification and radioulnar synostosis.[2,3,6,7] However, there is no report on the use of this technique in the treatment of acute elbow traumas.

In this retrospective study, we analyzed the results of cases with elbow dislocations with irreparable radial head fractures which were treated with repair of lateral and medial collateral structures in addition to radial head resection and anconeus interposition arthroplasty.

Patients and methods

Between 2003 and 2009, 22 patients with acute multiligamentous elbow injuries with reparable/irreparable radial head fractures were treated in our department. Seventeen patients had reparable radial head fractures and were treated by primary osteosynthesis of the radial head with plate-screws and lateral-medial ligamentous repair. Five patients (3 males, 2 females) with irreparable radial head fractures and a mean age of 42.6 years (range: 38–47 years) were operated during the same period. Four patients (2 males, 2 females) were admitted on an emergency basis after a fall on the outstretched hand. All had posterior elbow dislocations that were reduced under sedation and tenderness on both lateral and medial sides of the elbow and the proximal aspect of the radius. Radiological examinations revealed comminuted radial head fractures, and the patients were operated acutely. One patient was admitted 1 week after trauma. He had been operated by a surgeon independent of this study with only a radial head resection. He experienced tenderness, pain, and instability in the affected elbow.

In the surgical technique of the present study, a lateral approach was used. The elbow joint was approached within the dorsal one-third and anterior two-thirds of the extensor carpi ulnaris. A strip of extensor carpi ulnaris was left anterior to the anconeus muscle for additional stability of the lateral collateral structures of the elbow (Figure 1a). In all cases, it was observed that the radial head was irreparable with osteosynthesis; therefore, radial head resection was performed. Resection was minimized to the extent possible, taking as little bone from the radial neck as possible by trimming only sharp spikes with a rongeur. The anconeus muscle was mobilized distal to proximal by protecting its attachment with triceps fascia, as described by Morrey and Schneeberger.[2] The anconeus muscle was interposed into the radiocapitellar space beneath the dorsal one-third of the extensor carpi ulnaris that was left intact anterior to the anconeus (Figure 1b).

An oblique incision was performed on the medial side, and the ulnar nerve was explored and protected. In all cases, detachment of the MCL and partial detachment of the common flexor-pronator complex from the medial epicondyle were observed (Figure 1c). These structures were fixed to the medial epicondyle by suture anchors or directly to bone by creating tunnels in the medial epicondyle. The anterior capsule was fixed to the anterior part of the ulna with a suture anchor or by direct repair to the bone. After repair, the ulnar nerve was transported anteriorly in the subcutaneous tissue.

On the lateral side, the anconeus muscle was folded or rolled onto itself with absorbable sutures to serve as an interposition between the radius and capitellum, as described by Morrey and Schneeberger[2] (Figure 1d). The anconeus muscle was sutured to the surrounding soft tissues in the radiocapitellar space to prevent dislocation. Finally, the ruptured lateral structures were fixed using suture anchors or by creating tunnels in the epicondyle.

In the patient who had been admitted 1 week posttrauma, in addition to repair of the medial structures, MCL reconstruction was performed with free autologous palmaris tendon graft as described by Jobe et al. for added stability.[8]

In the postoperative period, the elbows were immobilized in 90° of flexion for 2 weeks, after which range of motion exercises were initiated using a hinged elbow brace. Range of motion was started first at 50°–100° and increased gradually. Full extension was allowed at 6 weeks. The brace was used for 8 weeks in total. Indomethacin prophylaxis (75 mg/day) against heterotopic ossification was administered to all patients for 4 weeks.

Radiographic examinations included an anteropos-

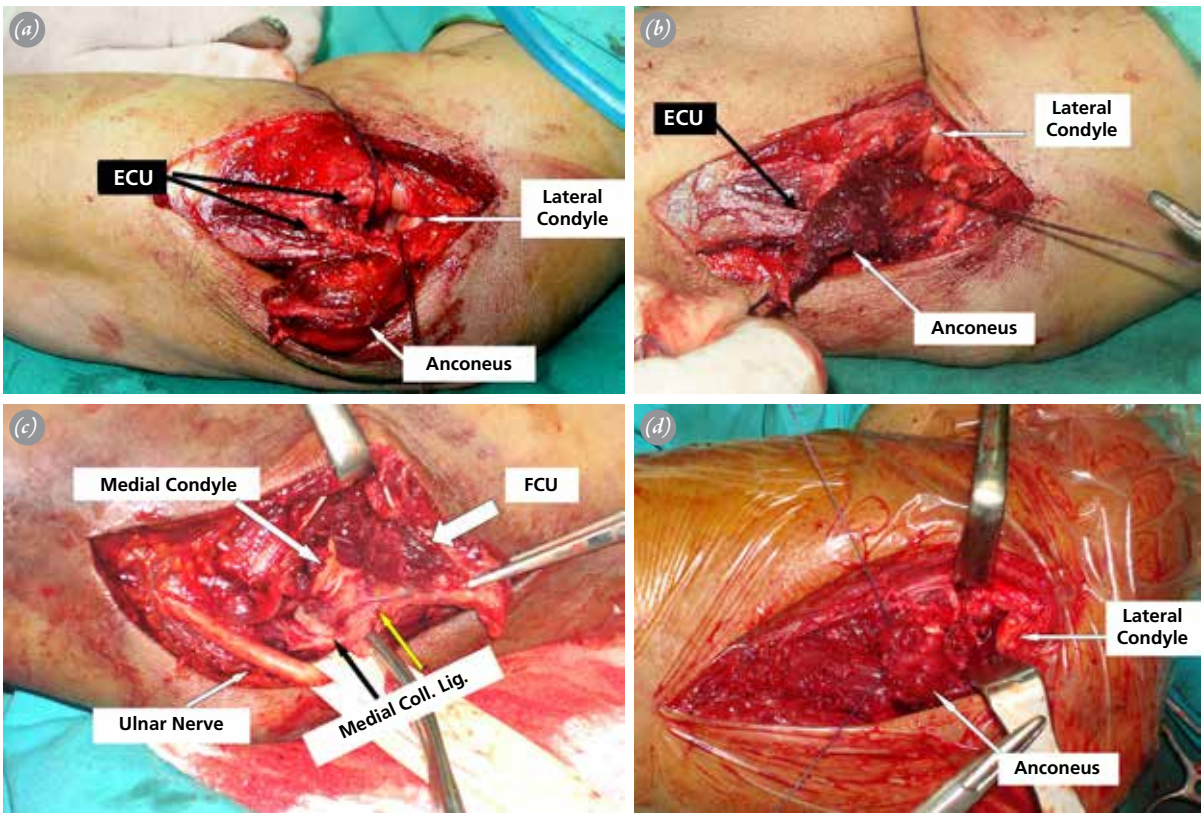

Fig. 1. **(a)** Left elbow lateral view. The approach is between the anterior two-thirds and posterior one-third of the extensor carpi ulnaris (ECU). The ECU strip was kept intact for added stability to the lateral collateral structures. The anconeus was mobilized distal to proximal, keeping the triceps attachments intact. **(b)** The anconeus was passed under the strip of the extensor carpi ulnaris (ECU). **(c)** Left elbow medial view. The rupture of the strip of medial structures from the distal medial humerus and posterior (black arrow) and anterior (yellow arrow) bands of the medial collateral ligament is seen. Part of the flexor carpi ulnaris (FCU) was also stripped from the medial epicondyle. **(d)** The anconeus was rolled onto itself with absorbable sutures to serve as a space-filling structure. It was interposed between the capitellum and proximal radius. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

terior and lateral radiograph of each elbow and a posteroanterior and lateral radiograph of both wrists with grip (stress radiograph). On posteroanterior wrist radiographs, a line was drawn parallel to the long axis of the radius. Two perpendicular lines to the long axis were drawn tangent to the tips of the radial and ulnar styloids. The distance between these 2 lines was measured and recorded. The difference of these measurements between operated and non-operated wrists was recorded as radial shortening. Secondly, the angle between the longitudinal axis of the humerus and that of the forearm determined cubitus valgus angle, as described by Coleman et al.[9] Finally, total radial lengths of operated and non-operated sites were measured from radial styloid to the most proximal part of the radius, and the difference was recorded as the amount of resection.

Results

Average follow-up was 63 months (range: 36–108 months). Mean Mayo Elbow Performance score was 91 (range: 85–100), mean Oxford Elbow score was 41.4 (range: 38–44), and mean Disabilities of the Arm, Shoulder and Hand (DASH) score was 13.76 (range: 9.2–26.7) at final follow-up visit.

Mean elbow flexion loss was 4.2° (range: 1°–8°). Mean elbow extension loss was 10.2° (range: 2°–27°). Mean forearm supination (with elbow in extension) loss was 5.2° (range: 4°–7°). On elbow radiographs, average increase in cubitus valgus angle compared to normal site was 5.4° (range: 1.8°–10.2°). No patient reported constraints in daily activities. There was no posterolateral rotatory instability in any patient in chair sign test, table top relocation test, or posterolateral instability test for the elbow, as described by O'Driscoll.[10] Nor was there heterotopic ossification in any patient. Average radial length on the operated side was 226.8 mm (range: 205.9–251 mm) and on the contralateral normal site was 237.3 mm (range: 212–260.2 mm). Average radial resection amount was calculated as 10.4 mm (range: 6.1–15.5 mm) (Figure 2).

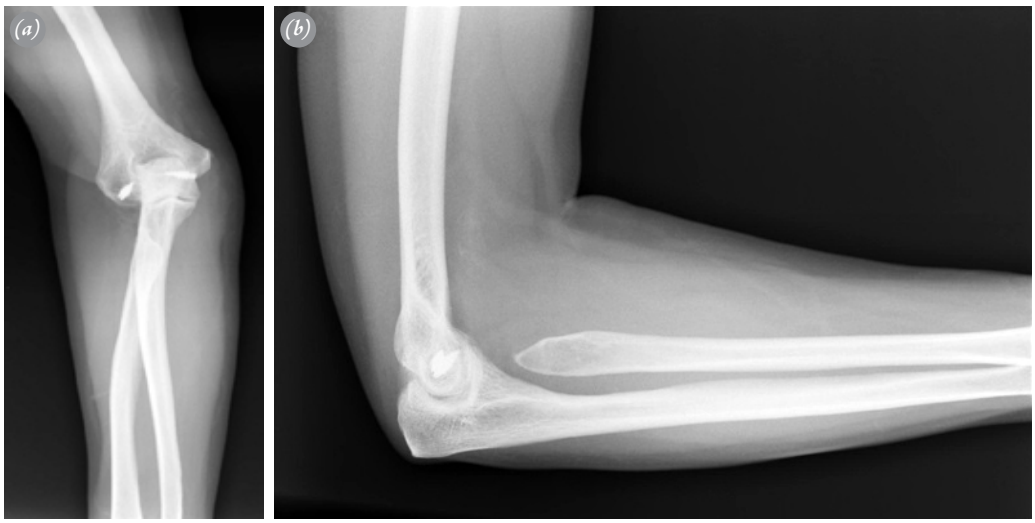

Fig. 2. Anteroposterior **(a)** and lateral **(b)** radiographs show the minimal extent of the radial head resection.

On wrist with grip posteroanterior radiographs, mean radial shortening was 1.39 mm (range: 0.11–2.5 mm). There was no wrist pain at final follow-up in any patient. Average Mayo wrist score was 91 points (range: 90–95).

There were no neurovascular complications during surgery or any ulnar nerve problems at final follow-up visit.

Discussion

Primary repair of the MCL in acute multiligamentous elbow dislocations is a controversial issue. Ring et al. suggested that it is not necessary to repair the MCL once fractures of the coronoid and radial head and disruptions of the lateral collateral ligament are repaired.[11] On the other hand, Cook et al.[12] and McKee et al.[13] suggested that if the elbow remains posteriorly or posterolaterally unstable after fixation and repair of all bony and soft tissues, then a medial approach is required to repair the MCL. Moreover, biomechanical studies have indicated that a metal radial head prosthesis can improve stability but cannot restore normal valgus stability completely in the absence of the MCL.[5] In light of these findings, we concur with Jeong et al. that primary repair of both lateral and medial structures provides satisfactory results.[14] The satisfactory results of our series (no subjective instability) according to the Mayo and Oxford elbow scores as well as the minimal degree of acquired cubitus valgus on elbow radiographs support the importance of primary MCL repair.

Furthermore, ulnar neuropathy is a common complication following MCL injury, and prophylactic release of the nerve and MCL repair are reported to prevent ulnar neuropathy.[15,16] In the present study, the ulnar nerve was routinely transposed anteriorly after MCL repair, which we believe might have prevented the development of ulnar neuropathy in our cases.

Anconeus interposition arthroplasty has been described for use in chronic cases with range of motion deficit or radiocapitellar impingement. However, we used this technique in acute injuries to prevent radiocapitellar impingement. We hypothesize that the anconeus itself–with its space-filling effect–could work to prevent proximal radial migration, i.e., Essex-Lopresti axial instability. Moreover, radial head resection in a stable elbow with intact MCL gives good results. As the medial structures were repaired in all cases, we believe that a more stable elbow that could allow radial head resection was achieved. In the literature, among cases with radial head resection in unstable elbows, proximal migration of the radius was reported between 1–8 mm.[9,17–20] In our cases, although an average proximal migration of the radius of 1.39 mm (range: 0.11–2.5 mm) was observed, the maximum migration (2.5 mm) was below the most commonly reported values.[9,17–20] Thus, we conclude that both stabilization of the medial structures and the space-filling effect of the transposed anconeus prevented greater migration. In addition, average Mayo wrist score was 91 points, and patients did not report any subjective wrist discomfort during conduct of their daily activities, which supports our hypothesis; however, a larger series with longer follow-up is recommended in order to reach a more definitive conclusion.

In addition, we believe that the degree of proximal radial resection is very important in preventing proximal radial migration. Limiting resection levels to less

than 20 mm was reported to limit proximal radial drift and, therefore the potential development of proximal radial impingement.[19] We only resected the broken loose fragments and trimmed the sharp ends of the fracture, thereby limiting proximal radial resection to less than 20 mm (average: 10.4 mm) in our cases, which we believe contributed to their successful outcomes.

There are unsolved problems regarding radial head arthroplasty, such as aseptic loosening, overstuffing, and capitellar erosion or even luxation after use of less-constrained prostheses.[21] Moreover, none of the currently available radial head prostheses can mimic the exact anatomy of the proximal radius and its anatomical relations with the capitellum and proximal ulna. Although radial head prostheses seem to be more rigid and thus able to prevent proximal radial migration, their use becomes problematic in view of the high complication rates.[3] In a recent study, Duckworth et al. reported high removal and revision rates after radial head replacement for acute fractures. They emphasized the importance of counseling young patients regarding the increased risk for secondary surgeries after radial head replacement.[4] Therefore, we suggest anconeus interposition arthroplasty after repair of medial and lateral ligamentous structures as an alternative to radial head arthroplasty.

The major limitations of our study are the lack of a control group and the small number of patients. We believe that a minimum 3-year follow-up period is necessary to draw conclusions; however, a larger patient group with a longer follow-up is necessary for reaching more definitive conclusions. Moreover, biomechanical studies are necessary to prove the effect of anconeusplasty in acute elbow trauma situations.

In conclusion, in the treatment of acute multiligamentous elbow injuries with irreparable radial head fractures, a combination of repair of the medial and lateral collateral structures, radial head resection, and anconeus interposition arthroplasty might be an alternative to provide satisfactory results.

Conflics of Interest: No conflicts declared.

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