Strategic approach to O’Driscoll type 2 anteromedial coronoid facet fracture

In Hyeok Rhyou, MD*, Kyung Chul Kim, MD, Ji-Ho Lee, MD, Seung Yeon Kim, MD

Department of Orthopaedic Surgery, Upper Extremity and Microsurgery Center, Pohang Semyeng Christianity Hospital, Pohang, Kyeongbuk, South Korea

Background: The purpose of this study was to suggest a strategic approach to the management of anteromedial coronoid facet (AMCF) fracture that is related to posteromedial rotational instability of the elbow through investigation of the surgical outcome of diverse combinations, including internal fixation of AMCF fractures and repair of collateral ligament injury.

Methods: The study enrolled 18 patients. On the basis of the size of the coronoid fracture and the degree of the soft tissue injuries that were evaluated with computed tomography, magnetic resonance imaging, and varus stress test under anesthesia, these fractures were managed differently. Functional outcomes were evaluated with the visual analog scale score, modified Mayo Elbow Performance Score, and Disabilities of the Arm, Shoulder and Hand score. Plain radiographs were used to evaluate the degree of arthrosis.

Results: There were 2 cases of O’Driscoll type 2, subtype 1 fractures; 14 cases of type 2, subtype 2 fractures; and 2 cases of type 2, subtype 3 fractures. Seven cases were managed with only AMCF fracture fixation, 4 cases with only lateral ulnar collateral ligament (LUCL) repair, 6 cases with concomitant repair of the LUCL and AMCF fracture, and 1 case with a conservative method. There were no significant differences among O’Driscoll types and among the subgroups of type 2-2 (P > .05). When the elbow showed instability on the varus stress test after AMCF fracture fixation, the soft tissue injuries of the lateral elbow were more severe (P = .015). Arthrosis was not correlated with the patient’s symptoms (P > .05).

Conclusion: AMCF fracture can be treated by only AMCF fracture fixation, only LUCL repair, or a combination of these techniques, depending on the size of the AMCF fracture fragment and the degree of the lateral soft tissue injuries.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Anteromedial coronoid facet fracture; lateral ulnar collateral ligament; posteromedial rotatory instability

The coronoid process is an important bony stabilizer of the elbow. It consists of an anterior projection and an anteromedial facet. The anteromedial facet is important for stability of the medial ulnohumeral joint. It serves as the insertion site for the anterior bundle of the ulnar collateral ligament (UCL), the primary stabilizer of the medial elbow. It also protrudes from the proximal ulnar metaphysis, so it lengthens the articular surface of the elbow.
elbow and helps prevent varus instability. However, approximately 60% of this anteromedial facet is unsupported by the proximal ulnar metaphysis and diaphysis. Under varus stress, it is prone to fracture, leading to post-eromedial rotational instability (PMRI).\(^{22}\)

Fractures of the coronoid process traditionally have been classified according to height of the fracture fragment,\(^{13}\) but this does not take into account the mechanism or location of the fracture and associated elbow injuries. In 2003, O’Driscoll et al proposed a more extensive classification system for coronoid process fracture based on fracture location and size, which helps predict associated injuries and injury mechanism.\(^{12,16,20,22}\) In particular, type 2 fracture, which is associated with PMRI of the elbow, is associated with injury to the lateral ulnar collateral ligament (LUCL) and the anteromedial coronoid facet (AMCF) fracture resulting from a varus postero-medial rotational injury force in forearm pronation.\(^{7,8,12,16,20,22}\) Consequently, until now, it was accepted that both the LUCL and the coronoid process should be repaired.\(^{22,23}\) However, the size of the AMCF fracture that can be treated without fixation when the fragment is too small or comminuted to be fixed has not been reported clinically, although it was estimated through biomechanical study.\(^{1,3,9,13,14,21}\) There have not been any clinical reports at all as to whether the LUCL can be treated conservatively if joint stability is maintained by fixation of large coronoid process fragments. Furthermore, there have not been any reports about the UCL injury combined with the AMCF fracture besides LUCL rupture in the PMRI. The purpose of this study was to identify the soft tissue injuries, including collateral ligament injury combined with O’Driscoll type 2 AMCF fracture, and to suggest an appropriate treatment algorithm by review of a series of cases surgically treated with various methods.

Materials and methods

Eighteen patients (16 men and 2 women), aged between 26 and 71 years (average, 39.4 years), affected by O’Driscoll type 2 AMCF fractures and surgically treated between January 2006 and December 2011 were considered for this study. Retrospective review of patients’ radiographs and medical records was performed. The right side was involved in 9 cases, and the left side was involved in 9 cases. The injury mechanism was a slip in 3 cases, fall from a height in 7 cases, traffic accident in 6 cases, and sporting accident in 2 cases. On the initial radiograph, 3 cases were accompanied by elbow dislocations; the others were observed as reduced states. The mean duration of follow-up was 37 months (range, 12-70 months).

Radiologic evaluation

All patients were evaluated preoperatively with plain radiography, computed tomography (CT), and magnetic resonance imaging (MRI), except 1 case that was not evaluated with MRI. We used 3-dimensional (3D) reconstruction CT in 15 cases and conventional CT and MRI in the remaining 3 cases with PACS system (Pi view; INFINITT, Korea) to classify the pattern of the coronoid process fracture and to evaluate the size of the coronoid process fracture fragment.\(^{13}\) We investigated the integrity of the UCL, LUCL, and adjacent flexor and extensor muscles with MRI obtained on a 1.5-T scanner (Intera; Philips, The Netherlands). T1-weighted, T2-weighted, and T2-weighted fat suppression MRI sequences in the axial, sagittal, and coronal planes based on the long axis of the humerus were acquired with the affected elbow in a long arm splint (60°-90° of flexion, depending on the pain and swelling). All patients underwent MRI within 5 days after trauma, and as a result of the retrospective study, a variety of MRI pulse sequences were used. MRI was evaluated by 2 fellowship-trained upper extremity orthopedic surgeons (I.H.R. and K.C.K.). The collateral ligament injuries were classified as complete rupture (the continuity of the collateral ligament was disrupted completely), as sprain (the continuity of the collateral ligament was disrupted partially or maintained, but the signal intensity of the collateral ligament in T2-weighted fat suppression MRI was increased), and as normal (the continuity of the collateral ligament was maintained and the signal intensity of the collateral ligament was seen normally). The adjacent muscle injuries were also classified similarly, and when both the collateral ligament and adjacent muscles were completely ruptured, we defined it as a complex dual lesion. We defined the lateral bone contusion as contusion that was in the radial head and posterior capitellum and the medial bone contusion as contusion that was in the medial coronoid process and medial trochlear. We assumed that lateral bone contusion results from pathologic forearm supination and that medial bone contusion results from varus force.\(^{15}\)

Postoperative radiologic evaluation of arthrosis was conducted with simple radiography by the Broberg and Morrey method\(^2\): grade 0, normal joint; grade 1, slight joint space narrowing with minimum osteophyte formation; grade 2, moderate joint space narrowing with moderate osteophyte formation; and grade 3, severe degenerative change with gross destruction of the joint.

Surgical technique and treatment algorithm

All operations were performed by the senior author (I.H.R.) according to our treatment algorithm under general anesthesia or brachial plexus block (Fig. 1). At first, we checked the size of the coronoid process fracture fragment. If it was <5 mm and the fixation seemed difficult, we performed the varus stress test under fluoroscopy with forearm pronation and checked whether the end point resistance was firm and the medial ulnohumeral joint congruency was maintained. If there was a firm end point resistance and the medial ulnohumeral joint congruency was well maintained, we performed a conservative treatment (Fig. 2). If not, we repaired the LUCL first with suture anchor through the lateral approach. After repair, the varus stress test with forearm pronation was performed again. Firm end point resistance was observed and the medial ulnohumeral joint space was well maintained in all instances. Additional fixation was not applied to the coronoid process fractures (Fig. 3).

When the coronoid process fragment was >5 mm and not comminuted, the medial approach was first used to fix it. The flexor-pronator muscle split approach was used, and cannulated screw, K-wire with tension band, and Mayo buttress plate were used for fixation. In cases 3 and 10, the AMCF had been comminuted into many pieces, and only the main fragments that
made up the anteromedial articular surface were fixed, leaving the small fragments. However, during elbow range of motion, it did not cause restriction of elbow motion or PMRI. In approaching the medial elbow for fixation of the coronoid process fragments, dissection or anterior transposition of the ulnar nerve was not performed. After the coronoid process had been fixed, the varus stress test was performed again under fluoroscopy with forearm pronation. If there was firm end point resistance and the medial ulnohumeral joint congruency was well maintained, the LUCL repair was not performed. Otherwise, an additional LUCL repair was performed (Fig. 4).

During the medial approach for fixation of the coronoid process, UCL ruptures were observed in 3 cases. We repaired them with a suture anchor (Fig. 5).

Postoperatively, the elbow joint was immobilized in a long arm splint at 90° of flexion for 1 week; after that, active-assisted range of motion exercise of the elbow joint was initiated with a hinged brace for protection of the LUCL and fixed coronoid process. After 6 weeks, the hinged brace was applied intermittently, and this was maintained for 12 weeks. At 4 months, return to daily and occupational activities was permitted.

Functional evaluation

Postoperative functional evaluation was performed with the Mayo Elbow Performance Score (MEPS), Disabilities of the Arm, Shoulder and Hand (DASH) score, and visual analog scale (VAS) score.

Statistical analysis

The clinical outcomes according to the various treatment methods in the O’Driscoll classification groups were compared by t test, analyzing the DASH, MEPS, and VAS scores. In type 2-2 AMCF fractures, multiple regression analysis was used to compare results of the treatment methods. In cases that were treated with coronoid process fixation first, multiple regression analysis was used to compare results of the treatment methods. Moreover, for O’Driscoll type 2-2 and 2-3 fractures, to investigate the correlation of the presence of the complex dual lesion and repair of the LUCL, the Fisher exact test was used. We used the Pearson correlation coefficient analysis to analyze the effect of arthrosis on the clinical outcomes. Interobserver variability for MRI readings was analyzed by Cohen κ coefficient analysis with the SPSS.

Results

The patients’ data are summarized in Table I. There were 2 cases of O’Driscoll type 2-1 fracture, one with a coronoid process fracture fragment of 3 mm, the other 4 mm. Although the LUCLs were ruptured, the UCLs were intact in all cases, which was confirmed on preoperative MRI and intraoperative valgus stress test under anesthesia, and only the LUCLs were repaired with suture anchors; on average, 1.1 (1-2) pieces were used. After repair, the varus stress test was performed under fluoroscopy with forearm pronation. Firm end point resistance was observed and the medial ulnohumeral joint congruency was well maintained in all instances. Additional fixation of the coronoid process was not performed.

With O’Driscoll type 2-2 fracture, there were 14 cases. In 13 of these cases, MRI was performed. In 11 of these cases, there was complete rupture of the LUCL, and in 2
cases, there was partial rupture. There were 2 cases of complete rupture and 11 cases of partial rupture of the UCL. The fracture fragments were, on average, 7.5 mm (5-10 mm). In 11 cases, the measured sizes of the coronoid process fragment were all >6 mm (range, 6-10 mm). In these cases, fixation of the coronoid process was performed first with a cannulated screw in 2 cases, K-wire with tension band wiring in 7 cases, and Mayo buttress plate in 2 cases. After the coronoid process had been fixed, the varus stress test was performed and the LUCL was repaired in 5 cases. In 6 cases, only the coronoid process fracture was fixed. In the remaining 3 cases, the coronoid process was <5 mm and fixation seemed difficult, so the varus stress test under fluoroscopy with forearm pronation was performed. In 2 cases, only the LUCL was repaired. The remaining case was treated conservatively with a long arm splint for 3 weeks because the size of the coronoid process fragment was 5 mm, and after anesthesia, the end point resistance was firm and the medial ulnohumeral joint congruency was well maintained in the varus stress test. Especially with O’Driscoll type 2-2, there were 2 cases that also involved a dislocation of the elbow. Of 2 two cases, 1 case (case 4) showed complete rupture of the UCL.

With O’Driscoll type 2-3 fractures, there were 2 cases in which the sizes of the coronoid process fracture fragment were 8 and 10 mm, respectively. In 1 case, the LUCL was completely ruptured with no injury to the UCL. As in the O’Driscoll type 2-2 fracture, the coronoid process was fixed first in both cases, and after the varus stress test, the LUCL was repaired in 1 case.

During the medial approach for fixation of the coronoid process, UCL ruptures were observed in 3 cases and repaired. In 2 of the cases, the anterior half of the UCL was ruptured at the ulnar attachment site, and suture anchors were used to repair it. In 1 case (case 4) that was accompanied by posterior dislocation, the UCL was ruptured at

Figure 2  Plain radiographs (A-C) and 3D reconstruction CT image (D) show O’Driscoll type 2-2 AMCF fracture that was treated without fixation. (E) The UCL, LUCL, and overlying flexor and extensor muscles were confirmed as having a partial rupture. (F-H) Plain radiographs at follow-up 4 years after the operation show grade 1 arthrosis of the elbow joint. (I-L) Full range of motion of the elbow and forearm was possible at the last visit.
the humeral attachment site, and thus it was also repaired with suture anchor.

The mean follow-up period was 37 months (12-70 months). The mean postoperative scores were 98 (85-100) for MEPS, 5.6 (0-35.8) for DASH, and 0.5 (0-3) for VAS. There were no significant differences in clinical outcome among groups according to the O'Driscoll classification (P > .05) (Table II). In the clinical outcomes of the type 2-2 AMCF fractures, there were no statistically significant differences by treatment methods except for MEPS in the treatment of the UCL. If the UCL was repaired, MEPS was significantly lower (P = .032) (Table III). In 10 cases, the arthrosis was grade 0; in 7 cases, grade 1; and in 1 case, grade 2. Statistically, the patients’ symptoms (VAS) were independent (P = .11).

Among type 2-2 and type 2-3 fractures, the coronoid process was fixed in 13 cases. In 12 of these 13 cases, MRI was performed. Of these 12 cases, the LUCL was repaired in 6 cases, and in 5 of the 6 cases (83%), a complex dual lesion was observed. Of the remaining 6 cases in which the LUCL was not repaired, 1 case of the 6 (17%) had a complex dual lesion, and the statistical variation was significant (P = .015).

Interobserver variability for MRI readings, which was analyzed by Cohen κ coefficient analysis, was 0.72 (P = .027) and 0.75 (P = .016), respectively. We used only one report for analysis of clinical outcome.

Figure 3  (A-D) O’Driscoll type 2-1 AMCF fracture that was treated with only LUCL repair. The coronoid process fragment was < 5 mm. (E) The UCL was intact, but overlying flexor muscles were partially ruptured, and the LUCL with overlying extensor muscles was confirmed as having a complete rupture. Complete rupture of the LUCL from the lateral epicondyle was found intraoperatively (F) and repaired by attaching the ligament to the original site with 2 suture anchors (G, H). At follow-up 30 months after the operation, degenerative change of the elbow joint was not found (I). The medial ulnohumeral joint congruency was well maintained, and lateral-side opening was not observed in the varus stress view with forearm pronation (J). (K-N) Full range of motion of the elbow and forearm was possible at the last visit.

Discussion

O’Driscoll et al introduced a classification of coronoid process fracture that reflects the elbow injury mechanism, and it is widely used because it can provide guidance for treatment.12,16,20,22 O’Driscoll type 1 coronoid process fracture mainly occurs along with dislocation of the elbow, whereas O’Driscoll type 2 fracture results from a varus injury force in forearm pronation and is associated with PMRI of the elbow joint.7,8,12,16,20,22 Particularly in this instance, by varus force in forearm pronation, the LUCL injury and the AMCF fracture occur, but it may not be evident on a simple radiograph and can be mistakenly overlooked. If it is not detected and appropriate treatment is not carried out in the early stages, post-traumatic arthritis occurs relatively quickly, and its outcome is known to be poor.4,12,22
It has been widely accepted until now that the appropriate treatment of coronoid process fracture associated with PMRI is internal fixation of the coronoid process fracture and repair of the ruptured LUCL. However, in actual practice, this approach may have many difficulties. First, there are many instances in which the coronoid process fracture fragments are too small and difficult to be fixed. However, if we can know the size of the AMCF fracture fragment that can be treated without fixation beforehand, fractures that are smaller would then be treated without fixation. Moreover, in the instance in which the coronoid process fracture is large but comminuted, causing fixation to be difficult, in theory, reconstruction of the AMCF would be necessary. Pollock et al presented a biomechanical study of AMCF fractures and suggested clinical size guidelines for fixation; fragments >5 mm (type 2-1), 2.5 mm (type 2-2), and regardless of size in a type 2-3 fracture, even if the LUCL has been repaired, can still cause instability of the elbow. However, fragments <5 mm are not easy to fix, and the size of a fragment that can be effectively treated conservatively, without having an impact on the function of the elbow, has yet to be determined. In this study, a total of 5 cases were treated without fixation for coronoid process fracture, and among them, in 2 cases that were O’Driscoll type 2-1 fractures, coronoid process fragment sizes were <5 mm and the LUCLs were repaired alone. The remaining 3 cases were O’Driscoll type 2-2 fractures, and their coronoid process fragments were 5 mm; 2 cases were treated with LUCL repair alone, and 1 case was treated conservatively. There were no significant differences in clinical outcomes between the O’Driscoll types (P > .05) (Table II). Therefore, not only in type 2-1 but also in type 2-2, in which the coronoid process fragment is <5 mm and difficult to fix, repair of the LUCL alone seems to be enough.

Second, if the coronoid process fragment is sufficient in size and can be fixed firmly, it is similar in theory to a simple elbow dislocation, and conservative treatment may be considered for the LUCL injury. This thought is synonymous with that of Ring, that is, in instances of elbow fracture and dislocation in which the fragments that make up the elbow are firmly fixed, the treatment process is equivalent to that of a simple elbow dislocation. However, there have not been any clinical reports of this idea. In this study, when the coronoid process fragment was >6 mm and it was determined that it could be fixed, in 11 cases of O’Driscoll type 2-2 and 2 cases of O’Driscoll type 2-3, the coronoid process fragment was fixed first. However, after that, when varus force was applied under fluoroscopy with forearm pronation, a firm end point was not present and the medial ulnohumeral joint congruency was not maintained in 6 cases. In those instances, the LUCL was repaired...
additionally. There were no significant differences in clinical outcomes between the 2 groups ($P$: VAS, .445; MEPS, .123; DASH, .339). Therefore, when the AMCF fragment is large enough for a firm fixation, the LUCL can be treated without repair in some instances, and the varus stress test after fixation of the coronoid process fragment is thought to be useful in determining whether the LUCL may be treated conservatively.

A complex dual lesion, which means complete rupture of both LUCL and adjacent extensor muscles, was observed more with statistical significance in patients whose LUCL was repaired after the fixation of the AMCF fracture ($P = .015$). In other words, when varus force was applied in a state of forearm pronation, if a firm end point was not present and the medial ulnohumeral joint was not maintained, the incidence of a complex dual lesion was significantly higher. Therefore, the varus stress test with forearm pronation is thought to be easy to apply; it can give a hint that there may be a complex dual lesion and may suggest that there is a need for repair of the LUCL.

Although 2 cases were accompanied by elbow dislocation, a complete rupture of the UCL was observed in only 1 case. In this case, it was observed that the dislocation was unlike the conventional posterior dislocation known as posterolateral-type or posteromedial-type dislocation. Instead, it is closer to a pure posterior type. Thus, it is much like that of a rare mechanism involving dislocation of the elbow caused by the varus stress mechanism under forearm pronation. The direction of this particular dislocation seems to be different from that of posterolateral or posteromedial dislocation of the elbow.

In the case of AMCF fractures, the existing reports indicate that early diagnosis and appropriate treatment are a must. If not, a complication such as arthritis occurs rapidly and is reported to have negative consequences.4,22 In our study, a total of 8 cases (44%) showed arthritic changes at the mean 3-year follow-up radiographic examination, grade 1 in 7 cases and grade 2 in 1 case. However, these arthritic changes show no significant difference with patients’ symptoms ($P$: VAS, .111; MEPS, .331; DASH, .316), and most patients show mild grade 1 arthritic changes. Given that the average functional score is 98 (85-100) for MEPS and 5.9 (0-35.8) for DASH, our various strategic approaches, considering the size of the coronoid process fracture fragment and the degree of soft tissue injury such as LUCL and overlying extensor muscles, could be an alternative to the previous treatment method that recommended coronoid process fixation with

![Figure 5](image-url)
LUCL repair in the coronoid process fractures associated with PMRI.

There are several limitations to this study. First, a retrospective study may have its own inherent limitations that the MRI and CT scan were not performed consistently. However, it should be considered that AMCF fractures themselves are not common, and there are many cases that were referred to our hospital after evaluation with MRI or CT scans. Second, the number of cases in each group varies; therefore, appropriate statistical analysis among subtypes may be difficult. However, in the case of O’Driscoll type 2 fractures, there is no definitive information on the frequency of subtypes, and appropriate statistical analysis among subtypes may actually be difficult because subtype 2-2 is really the most common subtype. Third, the firmness of the end point and the congruency of the medial ulnohumeral joint during the varus stress test with forearm pronation which were the most influential and decisive factors used by the authors, were checked subjectively, and their degree relied on the author’s subjective experience. Therefore, one can argue that there was lack of effort to measure them objectively. However, it should be considered fully that this simple physical examination was upgraded to tools for detection of the complex dual lesion through statistical analysis between the existence of the complex dual lesion and the result of the varus stress test with forearm pronation. Fourth, because the coronoid process fragments are displaced or comminuted, it is very difficult to measure the exact height of the coronoid fragment. The size of the coronoid process fragment could be overestimated or underestimated. To reduce the error, we

| Table I | Summary of patient demographics, surgical procedures, and outcomes |
|-------------------|-------------------|-------------------|-------------------|-------------------|
| Patient | Age (years) | Follow-up (months) | MEPS score | DASH score | VAS pain score (0-10) | Fracture classification | Elbow dislocation | Fracture size (mm) | MRI findings | Treatment |
| 1 | 45 | 53 | 13.3 | 2 | No | 4 | S | PR | CR | CR | No | Yes | No |
| 2 | 51 | 30 | 0 | 0 | No | 3 | S | PR | CR | CR | Yes | Yes | No |
| 3 | 47 | 40 | 0 | 0 | No | 7 | CR | PR | CR | CR | Yes | Yes | No |
| 4 | 37 | 48 | 0 | 0 | No | 9 | S | PR | CR | CR | Yes | Yes | No |
| 5 | 30 | 24 | 0 | 0 | No | 7 | S | PR | CR | CR | Yes | Yes | No |
| 6 | 26 | 13 | 8.3 | 1 | No | 9 | S | PR | CR | CR | Yes | Yes | No |
| 7 | 34 | 12 | 10 | 1 | No | 10 | S | PR | CR | CR | Yes | Yes | No |
| 8 | 47 | 48 | 3.3 | 0 | No | 7 | S | PR | CR | PR | Yes | No | Yes |
| 9 | 41 | 70 | 35.8 | 3 | No | 7 | S | PR | CR | PR | Yes | Yes | No |
| 10 | 41 | 14 | 0 | 0 | No | 8 | NA | NA | NA | NA | Yes | No | No |
| 11 | 36 | 76 | 2.5 | 0 | No | 6 | S | PR | CR | CR | Yes | Yes | No |
| 12 | 71 | 26 | 0 | 0 | No | 3 | NA | NA | NA | NA | Yes | No | No |
| 13 | 40 | 12 | 0 | 0 | No | 9 | S | PR | CR | CR | Yes | Yes | No |
| 14 | 39 | 60 | 0 | 0 | No | 5 | S | PR | CR | CR | Yes | Yes | No |
| 15 | 35 | 24 | 7.5 | 0 | No | 5 | S | PR | CR | CR | Yes | Yes | No |
| 16 | 38 | 48 | 15.8 | 1 | No | 5 | S | PR | S | PR | Yes | No | No |
| 17 | 29 | 20 | 3.3 | 0 | No | 8 | N | PR | S | PR | Yes | No | No |
| 18 | 32 | 50 | 10 | 0 | No | 10 | N | PR | CR | CR | Yes | Yes | No |

MEPS, Mayo Elbow Performance Score; DASH, Disabilities of the Arm, Shoulder and Hand; VAS, visual analog scale; MRI, magnetic resonance imaging; MCL, medial collateral ligament; LUCL, lateral ulnar collateral ligament complex; ORIF, open reduction and internal fixation for coronoid fracture; PR, partial rupture; CR, complete rupture; S, strain, N, normal; NA, not available.

| Table II | Difference in clinical outcomes between the O’Driscoll types (P value) |
|-------------------|-------------------|-------------------|-------------------|-------------------|
| Type 2-1 vs Type 2-2 | Type 2-2 vs Type 2-3 | Type 2-1 vs Type 2-3 |
| VAS | .478 | .635 | .423 |
| MEPS | .122 | .642 | .423 |
| DASH | .969 | .520 | .541 |

VAS, visual analog scale; MEPS, Mayo Elbow Performance Score; DASH, Disabilities of the Arm, Shoulder and Hand.

| Table III | Difference in clinical outcomes among the subgroups of O’Driscoll type 2-2 AMCF fractures (P value) |
|-------------------|-------------------|-------------------|-------------------|
| Coroid fixation | LUCL repair | UCL repair |
| VAS | .385 | .396 | .141 |
| MEPS | .293 | .409 | .032 |
| DASH | .342 | .346 | .105 |

AMCF, anteromedial coronoid facet; LUCL, lateral ulnar collateral ligament; UCL, ulnar collateral ligament; VAS, visual analog scale; MEPS, Mayo Elbow Performance Score; DASH, Disabilities of the Arm, Shoulder and Hand.
measured the longest length along the articular surface in 3D CT reconstruction images or in the sagittal plane of a conventional CT scan, as in the biomechanical study of Pollock et al. Under anesthesia, we performed a varus stress test in forearm pronation to check the elbow stability.

Conclusions

Unlike the typically recommended treatment procedure of fixation of the coronoid process fracture and repair of the LUCL, O’Driscoll type 2 AMCF fracture can be treated with only AMCF fracture fixation, only LUCL repair, or a combination of these techniques, depending on the size of the AMCF fracture fragment and the degree of the lateral soft tissue injuries. Furthermore, the varus stress test under fluoroscopy with forearm pronation is useful in helping to determine if the repair of the LUCL is necessary.

Disclaimer

The authors, their immediate families, and any research foundation with which they are affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

References