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ASSOCIATED INJURY BURDEN AND COMPLICATION PROFILE AFTER PLATE OSTEOSYNTHESIS FOR COMMINUTED OLECRANON FRACTURES: A PROSPECTIVE OBSERVATIONAL STUDY

Orthopaedics

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ABSTRACT

Background: Comminuted olecranon fractures are seldom isolated, and the dorsal proximal ulna is covered by little more than skin. The surgeon who chooses plate osteosynthesis therefore accepts two burdens: the injuries associated with the fracture, and the implant-related morbidity that follows fixation. This study quantified both. **Methods:** Thirty skeletally mature patients with comminuted olecranon fractures treated by open reduction and internal fixation with dorsal plating at a tertiary care teaching hospital were followed prospectively for 6 months. Associated coronoid, radial head, ligamentous and ipsilateral skeletal injuries were documented at presentation from clinical and radiographic assessment. Hardware impingement, elective implant removal and radiographic ulnohumeral arthritis were recorded at review.**Results:** Coronoid fracture was present in 13 patients (43.3%), radial head fracture in 12 (40.0%), elbow dislocation or subluxation in 11 (36.7%) and a Monteggia variant pattern in 10 (33.3%). Ipsilateral injury of another bone occurred in 5 patients (16.7%). Symptomatic hardware impingement affected 14 patients (46.7%) and 9 (30.0%) underwent elective implant removal after union. Early ulnohumeral arthritis was seen in 6 patients (20.0%), graded 1 in 3 patients and grade 2 in 3. **Conclusions:** Nearly half of these patients developed symptomatic hardware and almost a third underwent a second operation for its removal, with no failure of fixation. Implant removal should be presented at consent as an anticipated stage of treatment rather than as a complication.

KEYWORDS

Olecranon Fracture, Associated Injuries, Coronoid Fracture, Implant Removal, Hardware Impingement, Post-traumatic Arthritis

INTRODUCTION

Plate osteosynthesis is established as the treatment of choice for comminuted olecranon fractures, and contemporary series report union in 93-100% of cases with mean Mayo Elbow Performance Scores between 87 and 95.[1-4] The functional case for plating is therefore largely settled. What remains variable across the literature, and consequential for consent, is the cost side of the ledger.

That cost has two components. The first is intrinsic to the injury. A comminuted olecranon fracture is produced by an energy transfer sufficient to fragment an intra-articular surface, and that same energy is frequently expended on the adjacent coronoid process, radial head and collateral ligaments.[5,6] Ring et al showed that in transolecranon fracture-dislocations the determinant of outcome is stable restoration of the contour and dimensions of the greater sigmoid notch, of which the coronoid is an essential part.[7] An olecranon fracture accompanied by coronoid and radial head injury is a different clinical entity from an isolated one, and treating it as though it were isolated risks understating both the operative task and the prognosis.

The second component is created by the treatment. The dorsal proximal ulna lies immediately beneath the skin with minimal interposed subcutaneous fat, so a plate applied to that surface is palpable and, in many patients, symptomatic when the elbow is rested on a hard surface.[8,9] Reported rates of hardware irritation range widely, from 20% to over 70%, and the corresponding rates of elective implant removal are similarly dispersed.[2,3,10] This dispersion is not merely academic: a patient counselled that removal is unlikely, who then requires a second anaesthetic, has been poorly served.

This study was designed to quantify the associated injury burden at presentation and the implant-related and articular complications through 6 months in a consecutive series of comminuted olecranon fractures treated by plating, so that the two may be considered together. The functional and radiological outcomes of this cohort are reported separately in a companion paper.

Methods

Study design and participants

This prospective observational study was conducted in the Department of Orthopaedics of a tertiary care teaching hospital over 18 months, with Institutional Ethics Committee approval and written informed consent from every participant. Thirty patients with comminuted olecranon fractures managed by open reduction and internal fixation with plating were enrolled by purposive sampling. Inclusion required a fused olecranon epiphysis and a comminuted olecranon fracture, with open injuries of Gustilo-Anderson types 1, 2, 3A and 3B eligible. Gustilo-Anderson type 3C injuries with neurovascular deficit and pathological fractures were excluded. The cohort had a mean age of 40.93 (SD 13.06) years and comprised 21 men and 9 women; its demographic composition, fracture classification and functional and radiological outcomes are reported in full in the companion paper and are not duplicated here.

Assessment of associated injuries

Associated injuries were identified at presentation and confirmed intraoperatively. Radiographs in anteroposterior and lateral projections were obtained of the elbow with forearm, forearm with wrist, arm with elbow, and shoulder with arm, both to characterise the olecranon fracture and to identify injury elsewhere in the limb. Coronoid fracture, radial head fracture, ulnohumeral dislocation or subluxation and Monteggia variant configurations were recorded as present or absent. Ipsilateral fractures of other bones and injuries of other limbs were recorded separately. Distal neurovascular status was documented in every patient.

Operative and postoperative management

All patients underwent a posterior midline approach with elevation of the anconeus and triceps aponeurosis, restoration of articular fragment relationships with provisional Kirschner wire fixation, and application of a plate to the dorsal or posterolateral surface of the ulna with the proximal end contoured around the olecranon tip. Associated injuries were addressed at the same sitting according to their pattern. Splintage, where used for comminuted or unstable configurations, was retained for 2 weeks before mobilisation, and strengthening was deferred until radiographic union. Every patient was counselled preoperatively that the implant might become symptomatic and that removal after union was possible.

Assessment of complications

Patients were reviewed at 6 weeks, 3 months and 6 months. Hardware impingement was recorded when the patient reported pain or discomfort attributable to the implant, characteristically on direct pressure over the olecranon, in the presence of a palpable plate or screw head. Implant removal was undertaken electively after radiographic union in patients whose symptoms warranted it and who elected to proceed. Ulnohumeral arthritis was assessed on the 6-month radiographs and graded 1 or 2 according to the extent of joint space narrowing and osteophyte formation. Wound complications, infection and neurological deficit were recorded throughout.

Statistical analysis

Categorical data are presented as frequency and percentage. Because per-patient association between individual injuries and individual complications was not analysed, no cross-tabulation or inferential testing between injury pattern and complication is presented, and none should be inferred from the marginal frequencies reported.

RESULTS

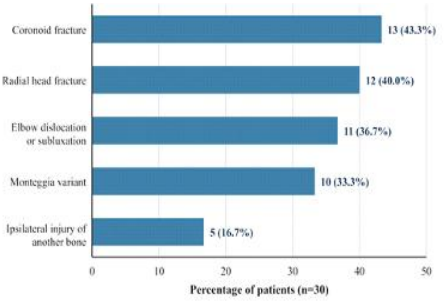
Associated injury burden

Injury confined to the olecranon alone was uncommon. A coronoid fracture accompanied the olecranon fracture in 13 patients (43.3%) and a radial head fracture in 12 (40.0%). Ulnohumeral dislocation or subluxation was present in 11 patients (36.7%), and 10 patients (33.3%) presented with a Monteggia variant configuration. Injury to another bone of the same limb occurred in 5 patients (16.7%), comprising distal humerus in 2, proximal humerus in 1, medial epicondyle in 1 and an unspecified site in 1. Injury outside the affected limb was rare, a single right acetabular fracture (3.3%) being the only such event (Table 1).

Table 1: Associated injuries at presentation (n=30)

Associated injury	Category	n	%
Coronoid fracture	Present	13	43.3
	Absent	17	56.7
Radial head fracture	Present	12	40.0
	Absent	18	60.0
Elbow dislocation or subluxation	Present	11	36.7
	Absent	19	63.3
Monteggia variant	Present	10	33.3
	Absent	20	66.7
Ipsilateral injury of another bone	Distal humerus	2	6.7
	Proximal humerus	1	3.3
	Medial epicondyle	1	3.3
	Site unspecified	1	3.3
	None	25	83.3
Injury of another limb	Acetabular fracture (right)	1	3.3

Figure 1: Frequency of associated injuries at presentation (n=30). Values are the number and percentage of patients in whom each injury was present. These are marginal frequencies; the extent to which individual injuries coexisted within the same patient was not analysed and the categories are therefore not mutually exclusive.



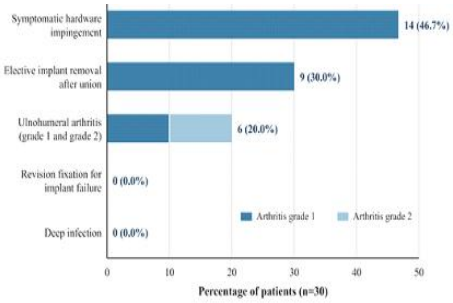
Implant-related complications

Symptomatic hardware impingement was recorded in 14 patients (46.7%), the remaining 16 (53.3%) reporting no implant-attributable symptoms. Nine patients (30.0%) proceeded to elective implant removal after radiographic union, so that approximately two-thirds of those with symptomatic hardware elected a second procedure while the remainder chose to tolerate their symptoms. There were no cases of implant failure, screw loosening or loss of reduction requiring revision fixation, and no deep infection or clinically significant ulnar nerve deficit was recorded in the series (Table 2).

Table 2: Implant-related and articular complications at 6 months (n=30)

Complication	Category	n	%
Symptomatic hardware impingement	Present	14	46.7
	Absent	16	53.3
Elective implant removal after union	Performed	9	30.0
	Not performed	21	70.0
Ulnohumeral arthritis	Absent	24	80.0
	Grade 1	3	10.0
	Grade 2	3	10.0
Revision fixation for implant failure	Performed	0	0.0
Deep infection	Present	0	0.0

Figure 2: Implant-related and articular complications through 6 months (n=30). The ulnohumeral arthritis bar is subdivided into grade 1 and grade 2, each affecting 3 patients (10.0%). No patient required revision fixation for implant failure and no deep infection occurred.



Early post-traumatic arthritis

Radiographic ulnohumeral arthritis was present at 6 months in 6 patients (20.0%), evenly divided between grade 1 in 3 patients (10.0%) and grade 2 in 3 patients (10.0%). Twenty-four patients (80.0%) showed no degenerative change at that interval.

DISCUSSION

Two findings define this series. First, the comminuted olecranon fracture in this population is usually one element of a complex elbow injury: coronoid fracture, radial head fracture, dislocation and Monteggia variant patterns each occurred in a third to a half of patients. Second, implant-related morbidity, not failure of fixation, is the dominant complication of plating: 46.7% developed symptomatic hardware and 30.0% underwent a second operation for its removal, while no patient required revision for loss of fixation.

The associated injury burden

The frequency of coronoid involvement in 43.3% of patients places a large proportion of this cohort in the territory of Mayo type III transolecranon fracture-dislocation rather than isolated olecranon trauma. Ring et al established that in these injuries the surgical objective extends beyond fixing the olecranon to restoring the contour and dimensions of the greater sigmoid notch as a whole, since it is the notch that confers ulnohumeral stability.[7] The concurrent radial head fracture rate of 40.0% and dislocation or subluxation rate of 36.7% reinforce that reading. The practical implication is preoperative rather than intraoperative: a comminuted olecranon fracture on a plain radiograph should prompt deliberate assessment of the coronoid and radial head, since discovering an unaddressed coronoid fragment after the olecranon has been plated leaves the surgeon with a poor set of options.

It should be stated plainly that these are marginal frequencies. The extent to which coronoid, radial head and dislocation coexisted within the same patients was not analysed, and the figures should not be read as defining discrete injury groups. Establishing which combinations carry the worst prognosis would require a larger series with per-patient pattern analysis.

Symptomatic hardware and implant removal

An impingement rate of 46.7% is high but entirely consistent with the range reported for dorsal plating. Bailey et al recorded a 20% hardware removal rate,[2] Buijze and Kloen a plate removal rate of 56% after locking compression plating of comminuted fractures,[3] and Park et al hardware irritation requiring removal in 71.4% of patients treated with plating supplemented by embedded subchondral Kirschner wires.[4] The anatomical explanation is not in dispute: there is minimal subcutaneous tissue over the dorsal proximal ulna, and plate edges and screw heads become perceptible whenever the patient leans on the elbow, an unavoidable posture in daily life and occupational activity.[8,11]

Rantalaiho et al described a paradox that bears directly on the present data: excellent postoperative reduction correlates with *higher* rates of reoperation and hardware removal, most plausibly because patients

who recover well are younger and more active and return to demanding physical work, at which point a prominent implant becomes intolerable.[12] Given that the same cohort achieved uniform union and excellent 6-month function, the removal rate of 30.0% reported here should be interpreted in that light rather than as evidence of technical shortcoming. The gap between the 46.7% who reported symptoms and the 30.0% who underwent removal also indicates that symptomatic hardware is frequently tolerable, and that the decision to remove is properly the patient's.

The consent implication is concrete. If nearly half of patients will develop implant symptoms and close to a third will undergo a further procedure, implant removal is better described at the outset as a possible planned second stage than as a complication disclosed after the event. Anticipating it also allows the removal to be scheduled after union rather than negotiated under the pressure of ongoing symptoms.

Early post-traumatic arthritis Radiographic ulnohumeral arthritis in 20.0% of patients at 6 months accords with the observation of Rommens et al that post-traumatic arthritis develops disproportionately in complex comminuted fracture patterns,[13] and with the finding of Eriksson et al that residual articular displacement beyond two millimetres is associated with significantly higher rates of secondary arthrosis.[14] Two qualifications are important. Six months is early for the assessment of degenerative change, and these grade 1 and 2 appearances represent the beginning rather than the end of a natural history that this study is not long enough to describe. Equally, radiographic degeneration and symptoms dissociate: the same cohort maintained excellent functional scores at 6 months despite these appearances, so the presence of early arthrosis on film should not by itself be communicated to patients as a poor result.

Limitations

The sample of 30 patients recruited by purposive sampling limits precision around each complication estimate, and confidence intervals about a 46.7% rate in 30 patients are correspondingly wide. Follow-up of 6 months is the principal constraint of this analysis: it is too short to observe the full trajectory of post-traumatic arthrosis, to capture late implant removals in patients still symptomatic at final review, or to record delayed infection. The absence of a comparator group treated by tension band wiring or alternative constructs means the complication burden described here cannot be positioned against that of another technique within the same population. Per-patient association between injury pattern and subsequent complication was not analysed, so no causal or predictive inference is available from these data. Finally, hardware impingement was recorded as a clinical judgement of implant-attributable symptoms rather than by a validated instrument, which introduces the possibility of assessor variability.

CONCLUSION

In this prospective series of 30 comminuted olecranon fractures treated by plate osteosynthesis, associated injury was present in a substantial proportion of patients, with coronoid fracture in 43.3%, radial head fracture in 40.0% and dislocation or subluxation in 36.7%, confirming that these are usually complex elbow injuries rather than isolated fractures. The dominant complication of treatment was implant-related: symptomatic impingement in 46.7% and elective removal in 30.0%, with no failure of fixation and no deep infection. Early ulnohumeral arthritis was evident in 20.0% at 6 months. Plating remains the appropriate treatment for these fractures, but the coronoid and radial head warrant deliberate preoperative assessment, and implant removal is best framed at consent as an anticipated second stage.

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REFERENCES

1. Chin TY, Murthi AM. Olecranon fractures: a comprehensive review of anatomy, biomechanics, classification, and treatment. J Am Acad Orthop Surg. 2021;29(17):e839-52.
2. Bailey CS, MacDermid J, Patterson SD, King GJW. Outcome of plate fixation of olecranon fractures. J Orthop Trauma. 2001;15(8):542-8.
3. Buijze G, Kloen P. Clinical evaluation of locking compression plate fixation for comminuted olecranon fractures. J Bone Joint Surg Am. 2009;91(10):2416-20.
4. Park JS, Cho SH, Min KT, Lee JH, Kim JH, Baek GH. Clinical results of treatment of comminuted olecranon fracture with free articular fragments using the embedded subchondral K-wire fixation along with plate fixation. J Hand Surg Am. 2025. doi:10.1016/j.jhsa.2025.07.035.
5. Watts AC, Singh J, Elvey M, Hamoodi Z. Current concepts in elbow fracture dislocation. Shoulder Elbow. 2021;13(4):451-8.
6. Manaan Q, Qulaghassi M, Bawale R, Kammela M, Singh B. Proximal ulna fractures in adults: a review of diagnosis and management. J Clin Orthop Trauma. 2021;20:101481.
7. Ring D, Jupiter JB, Sanders RW, Mast J, Simpson NS. Transolecranon fracture-dislocation of the elbow. J Orthop Trauma. 1997;11(8):545-50.
8. Adams JE, Sems SA, Steinmann SP. Open treatment of olecranon fractures with plate fixation. JBJS Essent Surg Tech. 2018;8(1):e1.
9. Hamoodi Z, Huette P, Taha ME, Shin AY. Olecranon fractures: current concepts in diagnosis and treatment. JBJS Rev. 2023;11(6):e22.00234.
10. De Giacomo AF, Tornetta P, Sinicrope BJ, Cronin PK, Althausen PL, Bray TJ, et al. Outcomes after plating of olecranon fractures: a multicenter evaluation. Injury. 2016;47(7):1466-71.
11. Hak DJ, Golladay GJ. Olecranon fractures: treatment options. J Am Acad Orthop Surg. 2000;8(4):266-75.
12. Rantalaiho IK, Laaksonen IE, Ryosa AJ, Perkonoja K, Isotalo KJ, Aarimaa VO. Complications and reoperations related to tension band wiring and plate osteosynthesis of olecranon fractures. J Shoulder Elbow Surg. 2021;30(10):2412-7.
13. Rommens PM, Kuchle R, Schneider RU, Reuter M. Olecranon fractures in adults: factors influencing outcome. Injury. 2004;35(11):1149-57.
14. Eriksson E, Sahlin O, Sandahl U. Late results of conservative and surgical treatment of fracture of the olecranon. Acta Chir Scand. 1957;113(2):153-66.
15. Gathen M, Jaenisch M, Peez C, Weinhold L, Schmid M, Welle K, et al. Plate fixation and tension band wiring after isolated olecranon fracture: comparison of outcome and complications. J Orthop. 2020;18:69-75.
16. Bethell MA, Doyle TR, Hurley ET, Pauzenberger L, Mullett H. Tension band wiring and plate fixation for olecranon fractures - a systematic review and meta-analysis. J Shoulder Elbow Surg. 2024;33(5):1151-60.
17. Villanueva P, Osorio F, Commessatti M, Sanchez-Sotelo J. Tension-band wiring for olecranon fractures: analysis of risk factors for failure. J Shoulder Elbow Surg. 2006;15(3):351-6.
18. Wenger D, Cornefjord G, Rogmark C. Cerclage fixation without K-wires is associated with fewer complications and reoperations compared with tension band wiring in stable displaced olecranon fractures in elderly patients. Arch Orthop Trauma Surg. 2022;142(10):2669-76.
19. Chalidis BE, Sachinis NC, Samoladas EP, Dimitriou CG, Pournaras JD. Is tension band wiring technique the gold standard for the treatment of olecranon fractures? A long term functional outcome study. J Orthop Surg Res. 2008;3:9.
20. Mahajan NP, Narvekar MA, Gadod LL, Kumar GSP. Comminuted olecranon fractures: locking compression plate fixation versus conventional plate fixation. Int J Res Orthop. 2021;7(5):1001-9.
21. Rochet S, Obert L, Lepage D, Lemaire B, Leclerc G, Garbuio P. Proximal ulna comminuted fractures: fixation using a double-plating technique. Orthop Traumatol Surg Res. 2010;96(7):734-40.
22. Wang Y, Tao R, Xu H, Cao Y, Zhou Z, Xu S. Mid-term outcomes of contoured plating for comminuted fractures of the olecranon. Orthop Surg. 2011;3(3):176-80.
23. Amis AA, Miller JH. The mechanisms of elbow fractures: an investigation using impact tests in vitro. Injury. 1995;26(3):163-8.
24. Cantore M, Candela V, Sessa P, Giannicola G, Gumina S. Epidemiology of isolated olecranon fractures: a detailed survey on a large sample of patients in a suburban area. JSES Int. 2022;6(2):309-14.
25. Harbrecht A, Hackl M, Ott N, Uschok S, Wegmann K, Mueller L, et al. Mayo classification of olecranon fractures revisited - assessment of intra- and interobserver reliability based on CT scans. J Orthop. 2024;52:1-6.
26. Anderson ML, Larson AN, Merten SM, Steinmann SP. Congruent elbow plate fixation of olecranon fractures. J Orthop Trauma. 2007;21(6):386-93.
27. Chin K, Hussain S, Mazis G, Arya A. Clinical anatomy and biomechanics of the elbow. J Clin Orthop Trauma. 2021;20:101485.