EAS Journal of Orthopaedic and Physiotherapy
Abbreviated Key Title: EAS J Orthop Physiother
ISSN 2663-0974 (Print) | ISSN 2663-8320 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-7 | Issue-4 | Jul-Aug, 2025 | DOI: https://doi.org/10.36349/easjop.2025.v07i04.016

Case Series

Surgical Treatment of Complex Fractures of the Upper End of the Humerus: A Retrospective Study of 25 Cases

El Amraoui I[1]*, Antar A[1], Laaraichi A[1], Aguenaoue O[1], Fekhaoui M.R[1], Mekkaoui M.J[1], Bouffetal M[1], Bassir R.A[1], Kharmaze M[1], Lamrani M.O[1], Elamraoui Ibrahim[2]

[1]Orthopedic and Trauma Surgery Department, Rabat University Hospital, RABAT, Morocco
[2]Resident Physician in Orthopedic and Trauma Surgery, Faculty of Medicine and Pharmacy of Rabat, Morocco

Article History
Received: 24.06.2025
Accepted: 26.08.2025
Published: 28.08.2025

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: Fractures of the upper end of the humerus pose a therapeutic problem, particularly for complex fractures with 3 and 4 fragments. The objective of this study is to determine the epidemiological-clinical characteristics of complex fractures of the upper end of the humerus in adults and to assess the functional and radiological outcomes of our series. This series consists of 15 cases collected at the orthopedics department of CHU Ibn Sina between 2021 and 2015. We recorded the epidemiological data of the patients and the circumstances of the trauma. The treatment was primarily surgical, either plate synthesis or nail fixation. The reduction was evaluated based on postoperative X-rays. At follow-up, functional results were assessed using the Constant score. Our series includes 8 men and 7 women, with an average age of 57 years; traffic accidents were noted in 48% of cases, and 4-fragment fractures were found in 76%.des cas. Plate osteosynthesis was used in 40% of cases and anterograde nailing was performed in 40% of cases. The average Constant score was 65.24 with extremes ranging from 35 to 88. We noted consolidation of fractures without malunion in 68%. In complex fractures of the proximal humerus, appropriately indicated osteosynthesis based on the patient and the fracture, along with early postoperative rehabilitation, results in acceptable functional outcomes.

Keywords: Complex fracture of the upper end of the humerus, osteosynthesis.

INTRODUCTION

Fractures of the proximal humerus (PHF) are becoming increasingly common and account for 5 percent of all fractures. Surgical treatment plays a crucial role, especially in complex PHFs, but the therapeutic management remains a subject of controversy due to the lack of a well-defined consensus. The aim of our work is to determine the epidemiological and clinical aspects of complex fractures of the proximal humerus in adults and to establish a clear vision of the functional and radiological outcomes.

METHODS

This is a monocentric retrospective study compiled from the Orthopedic and Traumatology Surgery department at CHU Ibn Sina in Rabat, focusing on 15 cases of complex fractures of the proximal humerus, over a period of 5 years from January 2021 to December 2025. The data were extracted from medical records and radiological archives. The collected variables included: sex, age at the time of trauma, medical and surgical history, affected side, profession, circumstances of the trauma, injury mechanism, and associated injuries with the proximal humerus fracture. A radiological assessment was performed immediately postoperatively and again at 4 to 6 weeks. A shoulder CT scan was requested whenever the standard assessment was deemed insufficient (Figure 1). At the end of this assessment, we defined two groups of complex fractures: fractures with 3 fragments and fractures with 4 fragments. We studied the time to intervention, the various surgical approaches, and the surgical techniques adopted: plate osteosynthesis and intramedullary nailing. Upon follow-up, the functional outcome was evaluated using the Constant score, based on radiological assessment to verify: good consolidation or non-union or malunion, and the inclination of the head by measuring the alpha angle, which is formed by the intersection of a line parallel to the axis of the humeral diaphysis and a line passing through the anatomical neck of the humeral head. When the alpha angle is between 30° and 60° (45°±

***Corresponding Author:** El Amraoui I
Orthopedic and Trauma Surgery Department, Rabat University Hospital, RABAT, Morocco

15°), the head is considered to be non-tilted from the front view. Beyond 60°, the displacement is in valgus, and below 30°, it is in varus. A search for necrosis of the humeral head or arthritis was also conducted.

Figure 1: CT of the shoulder shows a 4-part fracture of the upper end of the humerus
Figure 2: Reverse prosthesis of the right shoulder

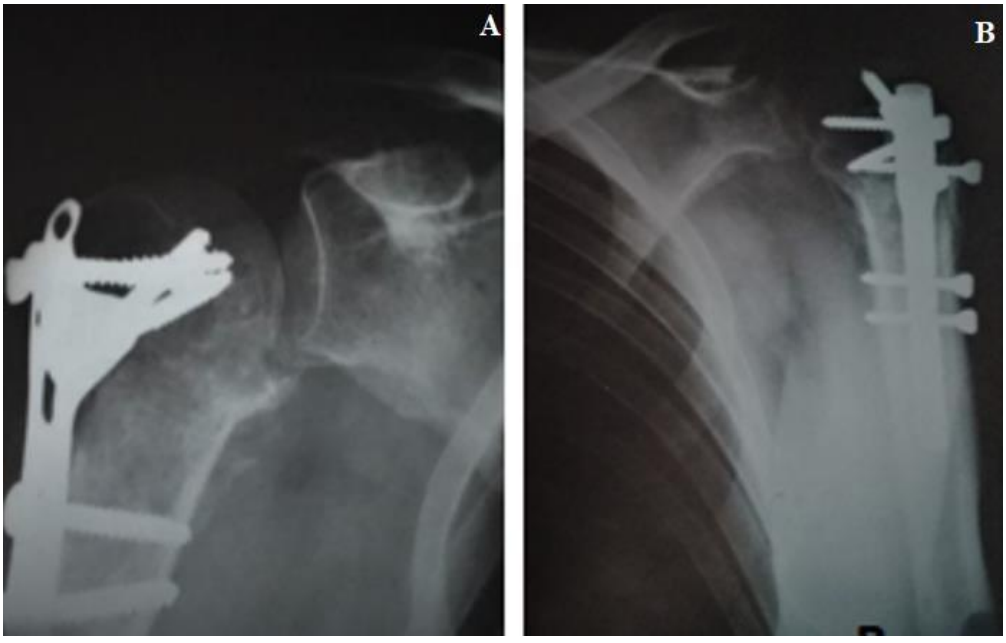

Figure 3: Healing after fixation with a screw plate

RESULTS

Our series includes 8 men and 7 women, the average age of our patients was 57 years with extremes ranging from 32 years to 86 years. We noted two peaks in frequency in our population; the first peak is between 30 and 39 years, and the second is between 50 and 69 years. Road traffic accidents (RTA) were noted in 48%, followed by domestic accidents in 40% of cases. The non-dominant side was found in 13 cases. Injuries associated with the FESH involved the lower limb in 2 cases: 1 case of femoral diaphyseal fracture and 1 case of fracture of both bones of the leg. Four-fragment fractures were found in 19 cases. patients, representing 76% of cases. The delto-pectoral approach (anterior) was used in 10 patients, or 60% of cases, while the supero-external (lateral) approach was performed in 5 patients, or 40% of cases. Osteosynthesis with a screw plate was used in 10 patients, and antegrade nailing was used in 5 patients, or 40% of cases. The analysis of post-operative X-rays showed satisfactory reduction in 80% of cases, that is, in 11 patients; we noted 4 cases of head tilt (3 cases in valgus and 1 case in varus) and one case of minimal head translation. Rehabilitation started between day 3 and day 45 post-operatively. The average Constant score was 68.14, ranging from 35 to 88. For cases treated with a locked plate, it was 68.1, the average Constant score was 60. The rate of consolidation in a good position reached 70%. We noted 1 case of nonunion, and 4 cases of malunion: 3 cases of 1 case in valgus and 1 case in varus (Figure 4, Figure 5) visible on ultrasound in 62% of cases from the Rochet series, where functional results were

satisfactory or very satisfactory in 89.6% of cases. The average Constant score following treatment with a locking plate was 68.1 in our series. This score is comparable to scores reported in the literature, as illustrated in Table 2. In cases of severe osteoporosis, our treatment of choice is prosthetic replacement, for which we obtained an average Constant score of 60.6. In the literature, functional results vary. This can be explained by the status of the rotator cuff and the type of arthroplasty used. In our series, we noted 4 cases of malunion, consisting of low-degree extra-articular malunion in varus, valgus, or translation, aligning with Südkamp's assertion that malunion is secondary to imperfect postoperative reduction. Pseudarthrosis was noted in 4% of cases, while Boileau [26] and Krishnan [27] found 13% and 21% of cases of pseudarthrosis, especially at the tuberosities.

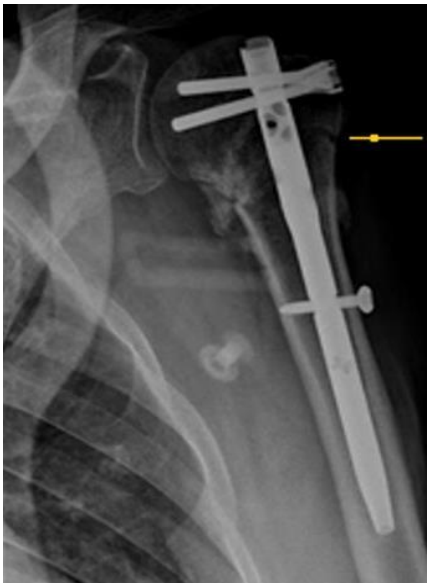

Figure 4: Nonunion of the metaphyseal fracture line

Figure 5: Malunion: minimal varus consolidation

Table 1: Constant score for nailing

Auteurs	Score de constant
Cuny *et al.,* [10] 2008	62
Boudard *et al.,* [11] 2014	60,6
Boughebri *et al.,* [12] 2007	62
Doursounian *et al.,* [13] 2011	66
Linhart *et al.,* [14] 2007	82
Notre série	66,4

Table 2: Constant score for locked plate

Auteurs	Score de constant
Königshausen *et al.,* [19] 2012	66
Solberg *et al.,* [20] 2009	68,6
Südkamp *et al.,* [21] 2009	70,6
Schliemann *et al.,* [22] 2015	71,3
Brunner *et al.,* [23] 2009	72
Notre série	68,1

Table 3: Constant score for arthroplasty

Auteurs	Score de constant moyen
Gallinet *et al.,* [22] 2009	39
Bufquin *et al.,* [23] 2007	44
Potage *et al.,* [24] 2015	48,4
Boileau *et al.,* [25] 2002	54
Notre série	60,6

DISCUSSION

In our study, FESH occurred at an average age of 55 years. They remain lower than those reported in European and American series [4-6], where the average age is between 60 and 72 years. The increase in age-related bone fragility is one of the risk factors predisposing to this type of fracture [7, 8]. In the literature, female predominance has been noted in some series [9, 10]. In our series, men were affected almost as much as women (12M/13F). Patients treated with an antegrade nail had an average Constant score of 66.4; these results are comparable to those reported in the literature as shown in Table 1 [11-14]. The good results appear to be related to the self-stabilizing nature of the locking screws, which allow for stability of the osteosynthesis [13, 15, 16]. A scar in the cuffs crossed by a nail was observed. In complex fractures of the upper end of the humerus, the treatment is surgical, with the primary objective being the anatomical reduction of these complex fractures. An appropriate osteosynthesis based on the patient and the fracture, along with early postoperative rehabilitation, can lead to acceptable functional results.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCES

1. Handoll HHG, Brorson S. Interventions for treating proximal humeral fractures in adults. Cochrane Database Syst Rev. 11 Nov 2015;(11):CD000434. Google Scholar
2. Gregory TM, Vandenbussche E, Augereau B. Surgical treatment of three and four-part proximal humeral fractures. Orthop Traumatol Surg Res. Févr 2013;99(1):S197-207. Google Scholar
3. Broekman ML, Carrière ME, Bredenoord AL. Surgical innovation: the ethical agenda. Medicine (Baltimore). Juin 2016;95(25):e3790. PubMed | Google Scholar
4. McLean AS, Price N, Graves S, Hatton A, Taylor FJ. Nationwide trends in management of proximal humeral fractures: an analysis of 77 cases from 2008 to 2017. J Shoulder Elbow Surg. Nov 2019;28(11):2072-8. PubMed | Google Scholar
5. Court-Brown CM, Garg A, MM. The epidemiology of proximal humeral fractures. Acta Orthop Scand. Janv 2001;72(4):365-71. PubMed | Google Scholar
6. Königshausen M, Kübler L, Godry H, Citak M, Schildh,Seybold D. Clinical outcome and complications using a polyaxial locking plate in the treatment of displaced proximal humerus fractures. A reliable system- Injury. Févr 2012;43(2):223-31. PubMed | Google Scholar
7. Roux A, Decroocq L, El Batti S, Bonnevialle N, Moineau G, Trojani C. Epidemiology of proximal humerus fractures managed in a trauma center. Orthop Traumatol Surg Res. oct 2012;98(6):715- PubMed | Google Scholar
8. Neer C. Displaced Proximal Humeral Fractures: PART II, treatment of three-part and four-part displacement. J Bone Jt Surg. Sept 1970;52(6):1090-103. Google Scholar
9. Oh JH, Song BW, Kim SH, Choi J-A, Lee JW, Chung SW et al. The measurement of bone mineral

density of bilateral proximal humeri using DXA in patients with unilateral rotator cuff tear. Osteoporos Int J Establ Result Coop Eur Found Osteoporos Natl Osteoporos Found USA. Nov 2014;25(11):2639-48. PubMed | Google Scholar

10. Cuny C, Scarlat MM, Irrazi M, Beau P, Wenger V, Lonescu N et al. The Telegraph nail for proximal humeral fractures: a prospective four. The Telegraph nail for proximal humeral fractures: a prospective four-year study. J Shoulder Elbow Surg. Août 2008;17(4):539-45. PubMed | Google Scholar
11. Boudard G, Pomares G, Milin L, Lemonnier I, Coudane H, Mainard D et al. Locking plate fixation versus antegrade nailing of 3- and 4-part proximal humerus fractures in patients without osteoporosis: comparative retrospective study of 63 cases. Orthop Traumatol Surg Res OTSR. Déc 2014;100(8):917-24. PubMed | Google Scholar
12. Boughebri O, Havet E. Treatment of proximal humeral fractures by Telegraph® nail: Prospective study of 34 cases. Revue de Chirurgie Orthopedique et Reparatrice de L'appareil Moteur. 01 Jun 2007. PubMed | Google Scholar
13. Doursounian L, Kilinc A, Cherrier B, Nourissat G. Complex proximal humeral fractures: a prospective study of 22 cases treated using the "Bilboquet" device. Orthopaedics & Traumatology. Surgery & Research. Février 2011;97(1): 58-66. PubMed | Google Scholar
14. Linhart W, Ueblacker P, Groterlinden L, Kschowak P, Briem D, Janssen A et al. Antegrade Nailing of Humeral Head Fractures with Captured Interlocking Screws. J Orthop Trauma. mai 2007;21(5):285-94. PubMed | Google Scholar
15. Giannoudis PV, Xypnitos FN, Dimitriou R, Manidakis N, Hackney R. "Internal fixation of proximal humeral fractures using the Polarus intramedullary nail: our institutional experience and review of the literature". J Orthop Surg. 19 déc 2012;7(1):39. PubMed | Google Scholar
16. Cuny C, feffer F, Irrazi M, Chammas M, Empereur F, Berrichi A et al. Proximal 4-part humerus fractures treated by antegrade nailing with self-stabilizing screws: 31 cases]. Rev Chir Orthop Reparatrice Appar Mot. 1 oct 2003;89(6):507-14.
17. Rochet S. Functional and sonographic shoulder assessment after Seidel nailing: A retrospective study of 29 cases. Revue de Chirurgie Orthopedique et Reparatrice de L'appareil Moteur. 01 oct 2006, 92(6):549-555. PubMed | Google Scholar
18. Solberg BD, Moon CN, Franco DP, Paiement GD. Surgical Treatment of Three and Four-Part Proximal Humeral Fractures. J Bone Jt Surg-Am. Juill 2009;91(7):1689-97. PubMed | Google Scholar
19. Südkamp N, Bayer J, Hepp P, Voigt C, Oestern H, Kääb M et al. Open reduction and internal fixation of proximal humeral fractures with use of the locking proximal humerus plate. Results of a prospective, multicenter, observational study. J Bone Joint Surg Am. Juin 2009;91(6):1320-8. PubMed | Google Scholar
20. Schliemann B, Hartensuer R, Koch T, Theisen C, Raschke MJ, Kösters C et al. Treatment of proximal humerus fractures with a CFR-PEEK plate: 2-year results of a prospective study and comparison to fixation with a conventional locking plate. J Shoulder Elbow Surg. Août 2015;24(8):1282-8. PubMed | Google Scholar
21. Brunner F, Sommer C, Bahrs C, Heuwinkel R, Hafner C, Rillmann P et al. Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locked plate: a prospective multicenter analysis. J Orthop Trauma. Mars 2009;23(3):163-72. PubMed | Google Scholar
22. Gallinet D, Clappaz P, Garbuio P, Tropet Y, Obert L. Fractures complexes trois ou quatre fragments de l´humérus proximal: hémiarthroplastie ou arthroplastie inversée? Étude comparative à propos de 40 cas Rev Chir Orthopédique Traumatol. 1 févr 2009;95(1):49-56. Google Scholar
23. Bufquin T, Hersan A, Hubert L, Massin P. Reverse shoulder arthroplasty for the treatment of three- and four-part fractures of the proximal humerus in the elderly: a prospective review of 43 cases with a short-term follow-up. J Bone Joint Surg Br. Avr 2007;89(4):516-20. PubMed | Google Scholar
24. Potage D. Hémi-arthroplasties et prothèses inversées à tige verrouillée sans ciment dans les fractures complexes de l´humérus proximal. Évaluation prospective multicentrique continue. 15 sept 2015;93.
25. Boileau P, Krishnan SG, Tinsi L, Walch G, Coste JS, Molé D. Tuberosity malposition and migration: reasons for poor outcomes after hemiarthroplasty for displaced fractures of the proximal humerus. J Shoulder Elbow Surg. Oct 2002;11(5):401-PubMed | Google Scholar
26. Boileau P, Pennington SD, Alami G. Proximal humeral fractures in younger patients: fixation techniques and arthroplasty. J Shoulder Elbow Surg. Mars 2011;20(2 Suppl):S47-60. PubMed| Google Scholar
27. Krishnan SG, Reineck JR, Bennion PD, Feher L, Burkhead Jr WZ. Shoulder Arthroplasty for Fracture: Does a Fracture-specific Stem Make a Difference? Clin Orthop. Déc 2011;469(12):3317-23. Google Scholar

Citation: El Amraoui I, Antar A, Laaraichi A, Aguenaoue O, Fekhaoui M.R, Mekkaoui M.J, Bouffetal M, Bassir R.A, Kharmaze M, Lamrani M.O, Elamraoui Ibrahim (2025). Surgical Treatment of Complex Fractures of the Upper End of the Humerus: A Retrospective Study of 25 Cases. *EAS J Orthop Physiother, 7*(4): 115-119.