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Case Report

Complex proximal humerus fracture with associated glenoid fracture – Solution with reverse shoulder arthroplasty and glenoid fixation

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ABSTRACT

We present a case of a complex proximal humerus fracture combined with an articular glenoid fracture, in an elderly patient. This is a rare combination of injuries, and its proper treatment is scarcely described in the current literature. Our selected treatment consisted of reverse shoulder arthroplasty combined with glenoid fracture fixation, which has been reported only once in the current literature. At 18 months follow-up we report a result consisting of great pain control, appropriate mobility and functional score, and absence of signs of glenohumeral instability or implant loosening, which is in line with has been previously described. We conclude that this surgical approach is a great alternative to others such as reverse shoulder arthroplasty combined with glenoid grafting, or shoulder hemiarthroplasty.

Introduction

Complex proximal humerus fracture (PHF) combined with an articular glenoid fracture is a rare injury. Treatment strategy is scarcely defined in the current literature. Despite PHF's being common in the elderly population [1], glenoid fractures are rare. Reverse shoulder arthroplasty (RSA) is a growing solution for treating PHF's in the elderly, overcoming fracture comminution, tuberosity non-union or previous rotator cuff disease [1,2].

Treatment of articular glenoid fractures depends on glenohumeral instability, fragment size and displacement [3]. The most used technique is open reduction and internal fixation with cannulated screws, despite recent appearance of arthroscopic treatment [3]. However, the use of RSA combined with glenoid fixation has been described only once in the current literature [4]. Therefore, we describe a case of a four-part PHF with glenoid fracture treated using RSA and open reduction and fixation of the glenoid.

Case report

A 67 years old female with a personal history of type-two diabetes mellitus, hypertension, dyslipidaemia, obesity and osteoporosis, was diagnosed with a four-part PHF after a low-energy fall with direct trauma to the right shoulder. Radiographs showed fragment displacement and tuberosity comminution (Fig. 1). No neurovascular deficits were identified. Computerized tomography diagnosed a fracture of the anteroinferior glenoid rim, with a displaced 10.8mm fragment, making up approximately 40% of the

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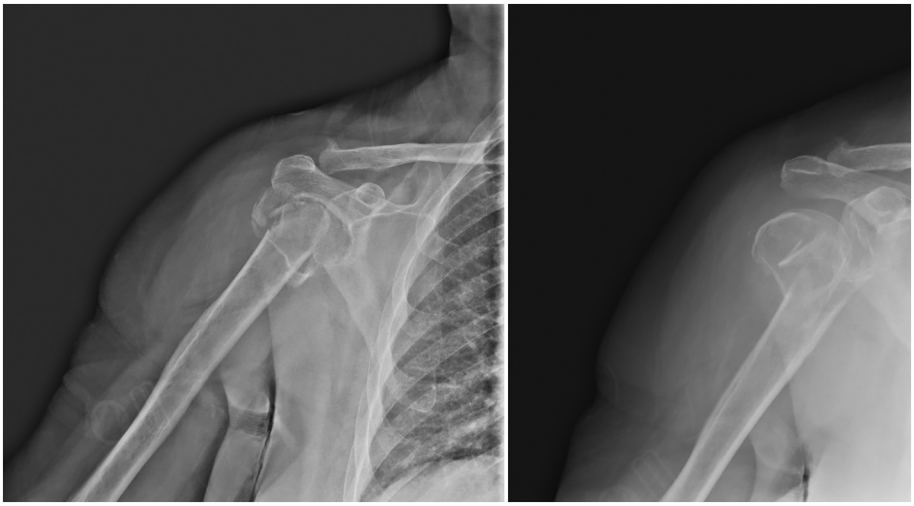

Fig. 1. Legend – Anteroposterior neutral rotation (left) and internal rotation (right) radiographs of the right shoulder, showing a 4-part PHF with tuberosity comminution and significant displacement of the fracture fragments.

anteroposterior glenoid surface (Figs. 2 and 3). There were no previous injuries to the shoulder. Patient gave consent for RSA and glenoid fixation.

Surgery was performed 12 days after injury, under general anaesthesia, in beach-chair position, with intra-operative fluoroscopy. Deltopectoral approach was used. Rotator cuff insertions were tagged with sutures. Suprapectoral tenodesis of the long head of the biceps was performed. The glenoid fracture was reduced and provisionally fixed using two kirschner wires. The central guide wire for baseplate placement was positioned, and the previously placed kirschner wires were adjusted for not interfering with glenoid reaming, central peg or baseplate screws trajectory (Fig. 4). The baseplate was then partially introduced, and before its final impaction the glenoid fracture was definitively fixed with two partially threaded cannulated screws. Additional baseplate fixation was achieved with three polyaxial locking screws – superior, inferior and posterior. A 38 mm glenosphere was used. A cemented humeral stem with 155° neck-shaft angle was placed in 10° retroversion, with a 38 mm humeral cup. Proximal hydroxyapatite coating and epiphyseal collar were used for improved tuberosity fixation. This was performed with high resistance sutures – two horizontal between each tuberosity and the collar, two horizontal between both tuberosities, and two vertical between each tuberosity and the metaphysis. Operating time was 2h40min, with estimated blood loss of 400 cc. Hemoglobin and hematocrit values fell from 12.9 g/l and 38.2% respectively to 10.3 g/l and 31% postoperatively. No blood transfusions were required. There were no intraoperative complications such as neurovascular injury, iatrogenic fractures, or malreduction.

Rehabilitation included passive shoulder motion at postoperative week two, active assisted motion at six weeks. At 18 months follow-up patient presented a pain-free shoulder, with 140° active abduction, 150° anterior elevation, 60° external rotation with the shoulder in 90° of abduction and internal rotation to hip level. Constant Score at 18 months was 63 points, compared to 79 on the unaffected shoulder. There were no clinical or radiographic signs of joint instability, glenoid fragment displacement, scapular notching or baseplate loosening (Figs. 5 and 6).

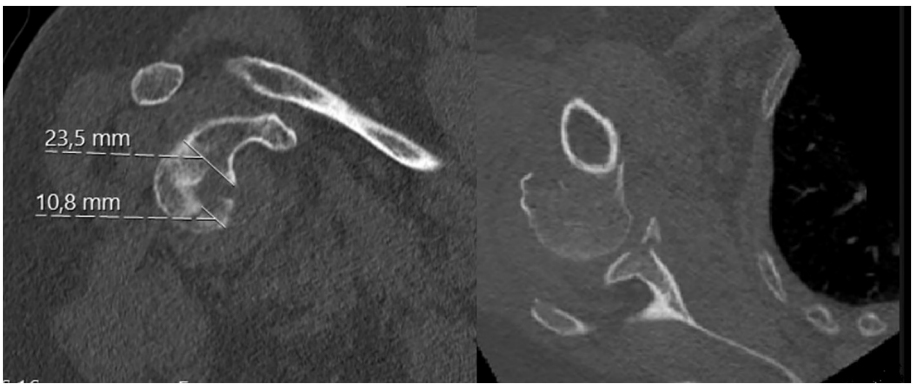

Fig. 2. Legend – Coronal plane computed tomography image (left) and axial plane image (right), confirming glenoid articular fracture. Measurements indicate a 10.8 mm width fragment relative to a 23.5 mm total anteroposterior cross-section of the glenoid.

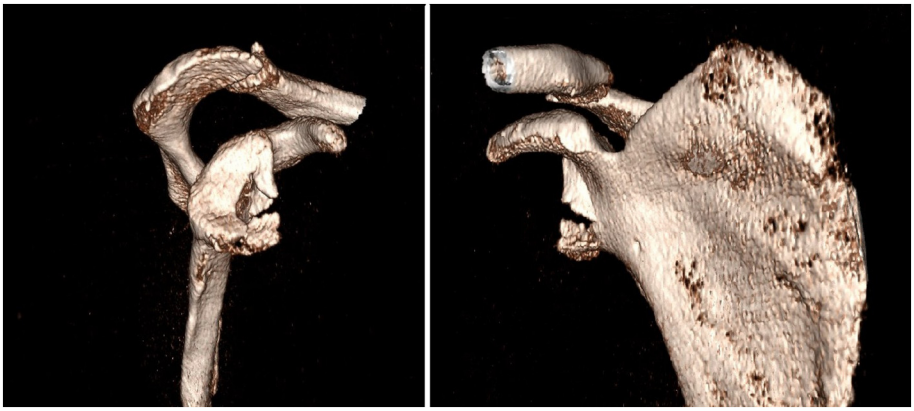

Fig. 3. Legend – Computed tomography 3D reconstruction lateral view (left) and anterior view (right) confirm glenoid articular fragment position and displacement.

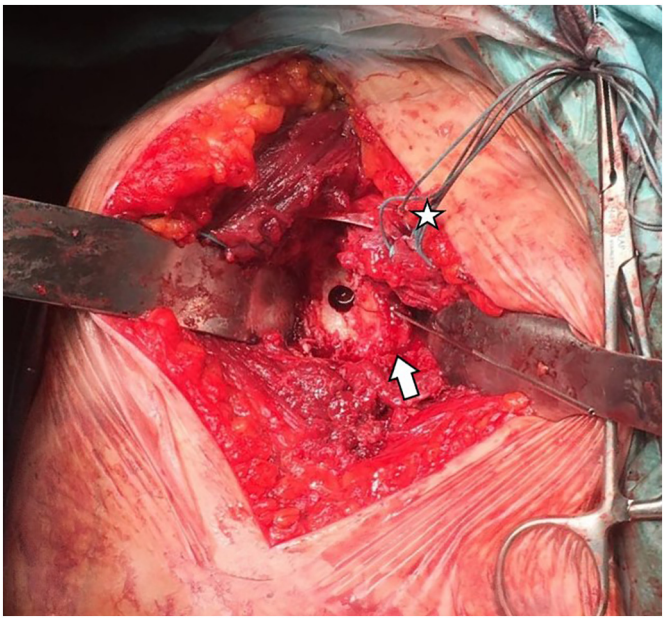

Fig. 4. Legend – Intra-operative picture shows anterior glenoid fragment (white arrow) provisionally fixed with kirschner wire. Central drilling of glenoid for baseplate peg has been performed. Lesser tuberosity referencing (white star) can also be seen.

Discussion

Most PHF's are amenable to conservative treatment [5]. However, displaced two, three or four-part fractures in elderly osteoporotic patients benefit from surgical treatment [1]. In the 70's Neer stated that complex fractures should be treated using arthroplasty, reporting positive results at the time. Hertel described criteria for predicting humeral head ischemia - < 8 mm of calcar extension of the head fragment, disruption of the medial cortex, and anatomical neck fracture -, preferring arthroplasty in these patients. Studies demonstrate a significant advantage in terms of quality of life of hemiarthroplasty compared to conservative treatment in elderly patients [5]. However, this advantage is mainly due to pain relief, since the level of mobility is similar, as non-union of the tuberosities is common – making its results disappointing in the elderly [5,6].. Internal fixation is also vulnerable to complications in this population, namely non-union, joint perforation and avascular necrosis of the humeral head, despite being the treatment of choice in young patients [1,6].

Thus, RSA, originally developed to treat rotator cuff arthropathy, rheumatoid arthritis, or revision of both internal fixation or anatomical arthroplasty [2], has gained popularity in the primary treatment of complex PHF's in the elderly. Its advantages are maintaining anterior flexion and abduction of the shoulder even with tuberosities non-union, responding to previous rotator cuff pathology, and ensuring a faster and more predictable post-operative recovery [1,2]. As such, RSA was chosen for this patient.

Criteria for surgical treatment of glenoid fractures remains to be clarified. In articular fractures, treatment depends on

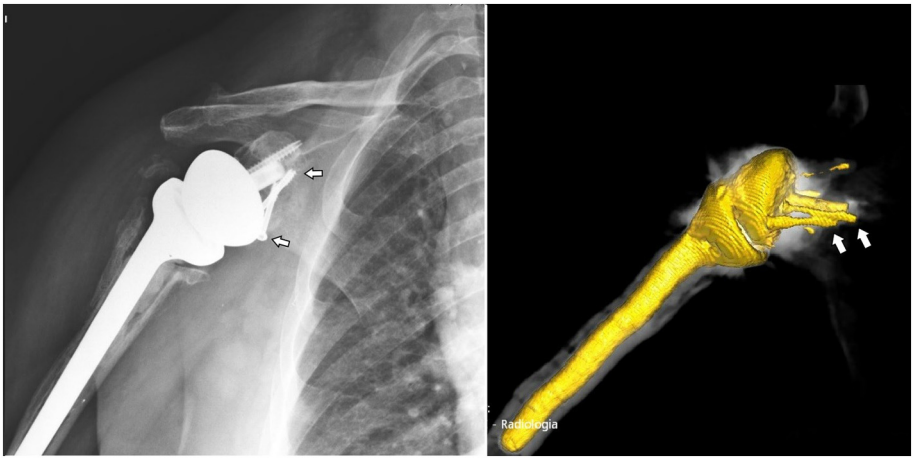

Fig. 5. Legend – 18 months post-operative anteroposterior radiograph (left) and anterior view of computed tomography 3D reconstruction (right). It is possible to see the relation of the cannulated screws (white arrows) relative to the baseplate screws. Baseplate shows no signs of loosening.

Fig. 6. Legend – 18 months post-operative evaluation showing functional, pain-free range of motion.

glenohumeral instability, displacement, and fragment size [3]. The critical point of glenohumeral instability was defined as a defect > 21% of the articular surface [7]. Displacement of 4-5 mm is commonly used as a surgical indication [3]. Glenoid bone defect is also a common contraindication for RSA due to risk of baseplate loosening [8]. However, in the context of an acute fracture of the glenoid rim, literature is scarce regarding how its fixation influences RSA baseplate stability or RSA glenohumeral stability.

In a previous case series of two complex PHF with bone Bankart lesion, both were treated with hemiarthroplasty and glenoid rim fixation with bone anchors [9]. No patients presented glenohumeral instability at one year follow-up. Despite being a small series, it displays the relevance of fixing glenoid rim fractures to ensure adequate joint stability after shoulder arthroplasty.

A long-term study demonstrated the importance of autograft in RSA for addressing glenoid defects caused by joint wear or dysplasia [10]. Disadvantages of this technique are its difficulty, the risk of graft resorption, and the possible need of glenoid implant reorientation and/or using a longer peg for obtaining proper fixation [8,9]. A case series of 26 patients with PHF and glenoid fractures were treated with RSA and anterior autograft [8]. In all cases, the glenoid defect corresponded to 22–30% of the joint surface. Final average active range of motion was 135° anterior elevation, 122° abduction and 30° external rotation. Average Constant score was 68.2. There were no cases of glenohumeral instability, baseplate loosening, scapular notching or graft resorption. However, the authors do not recommend this technique in defects > 25% of the joint surface due to technical difficulties.

A single case of RSA with glenoid osteosynthesis was reported – a 64-years old female with a four-part PHF combined with glenoid rim fracture making up 30% of the joint surface [4]. At one year follow-up average active range of motion was 160° anterior elevation, 45° external rotation and S1 internal rotation. No baseplate loosening or glenohumeral instability was reported.

Conclusion

Our solution for this case was effective in recovering joint motion, avoiding implant-related complications, and maintaining joint

stability. Standing out as an alternative is the use of autograft to increase baseplate fixation, described mainly for chronic glenoid defects in RSA or revision RSA. In situations where preserving native bone is possible, the authors believe osteosynthesis is preferable, which is supported by the present paper.

Choosing RSA over HA or PHF fixation is consensual in the literature in the case of elderly patients with complex fractures, osteoporosis and criteria for humeral head ischemia.

Declaration of competing interest

None.

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