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Osteosynthesis of Locked Posterior Impaction Fracture-Dislocation of the Humeral Head: Technical Note

Dr Salif KONE[2*], Dr Aboubacar Sidiki SANGARE[2], Dr François FERCHAUD[1], Dr Carlos DOS REMEDIOS[1], Dr Youssouf FOFANA[3], Dr Mory KONE[3]

[1]Orthopedic and Trauma Surgery Department La Rochelle Hospital
[2]Mali Hospital
[3]Somine Dolo Mopti Hospital

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***Corresponding author:** Dr Salif KONE
Mali Hospital

Abstract **Case Report**

The posterior impaction dislocation fracture of the humeral head is a rare trauma in daily practice. Few articles are published in the literature, most often with small series and various surgical techniques. We describe a technique for osteosynthesis of complex posterior dislocation fractures of the humeral head by double superior-deltoid trans-deltoid approach associated with a vertical posterior approach. We do not recommend a reduction alone with the finger and the use of spacers against elbows, even with foam tips to open up the head. We recommend the use of a graft repellent and osteosynthesis material by self-tapping cannulated screws buried with double screwing on temporary pins associated with a proximal humeral locked plate. The articular approach passing through the posterior portion of the rotator cuff allows joint control. Extensive humeral disinsertion of the rotator cuff is not advised. The placement of a shoulder arthroplasty is an alternative to be offered in the elderly, or in the event of failure or impossibility of conservative surgery

Keywords: Fracture-Dislocation, posterior, humeral head, impactional, meshed.

1. INTRODUCTION

Isolated posterior glenohumeral dislocation is a rare injury estimated at between 2 and 5% of all shoulder dislocations [1,2]. Posterior glenohumeral fracture dislocation is rarer (0.9% of shoulder dislocations) [3] and is related to bone impaction of the head against the posterior rim of the glenoid cavity. Bone lesions are most often of the reverse Hill Sachs type [4]. In this type of injury, disimpaction surgery is sometimes necessary in the event of head involvement by transfer of the lesser tubercle, allograft or filling of the bone defect. A fracture of the anatomical neck is sometimes associated, most often requiring open osteosynthesis and sometimes immediate prosthetic replacement. More rarely, surgical options and estimation of the prognosis for consolidation and vitality of the humeral head are made more complex in the event of complete fracture separation of the humeral head [5].

The choice of approach in these complex posterior interlocking fractures and dislocations of the humeral head is guided by the need for optimal non-traumatic manipulation and reduction as well as the establishment of stable osteosynthesis using a proximal humeral locking plate. We describe an osteosynthesis technique using a double superolateral and posterior approach.

2. Surgical Technique (fig. 1-2-3)

The surgical procedure is performed under general anesthesia, with the patient in a semi-sitting position at approximately 50°. We advise against any attempt at closed reduction by external traction and rotation maneuver given the significant risk of aggravating the fracture with complete detachment of the articular surface of the head and epiphyseal vascular damage. A dual approach is performed. A superolateral approach is combined with a posterior approach. The 3 cm vertical posterior approach with finger discision through the deltoid fibers between the infraspinatus and teres minor muscles aims to provide minimally invasive access to the dislocated posterior part of the humeral head. Finger reduction is most often insufficient due to the significant constraints of embedding the fracture line and the posterior capsular and muscular thickness. Furthermore, the operator needs both hands available to set up the osteosynthesis. A graft punch with a flat, wide tip is used to disengage the posterior portion of the humeral head by a postero-anterior and lateral push. The arm is positioned in adduction and lateral traction of the

head is performed at the same time as the push of the graft driver. The graft driver positioned on the posterior surface of the reduced head helps to combat the tendency for posterior re-engagement of the head and aids in osteosynthesis by its counter-support effect (fig.1). We do not recommend the use of clamps because the positioning of the anterior and posterior branches of the clamp is difficult due to the limited working space. Furthermore, when tightening the clamp, there is a risk of piercing the articular cartilage and creating a fracture fragment. We also do not recommend the use of counter-angled retractors, even those with blunt tips, to free the head because these instruments cause significant stress on the fracture sites with a lever arm that is difficult to control during the rocking movement to free the head. A joint approach via the superoexternal approach allows direct control of the joint reduction by longitudinally incising the posterior musculotendinous portion of the supraspinatus or the anterior part of the infraspinatus according to the direction of the fracture line on the preoperative CT scan (fig.2). The graft driver held by the operating assistant then allows the operator to free both hands for the anteroposterior compression screwing of the bone fragments of the humeral head by two buried self-tapping cannulated screws of 4 mm diameter after the temporary placement of two percutaneous guide pins. The superoexternal approach with control of the axillary nerve allows the placement of a 3.5 mm multidirectional proximal lateral humeral locked plate (fig.3).

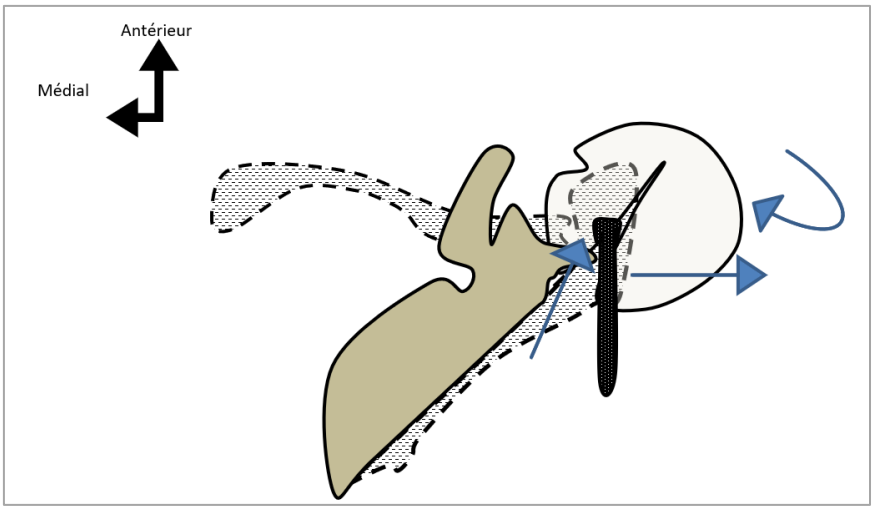


Figure 1. A wide, flat-tipped graft pusher is used to disengage the posterior portion of the humeral head. Posteroanterior and lateral thrust with lateral traction and gentle external rotation

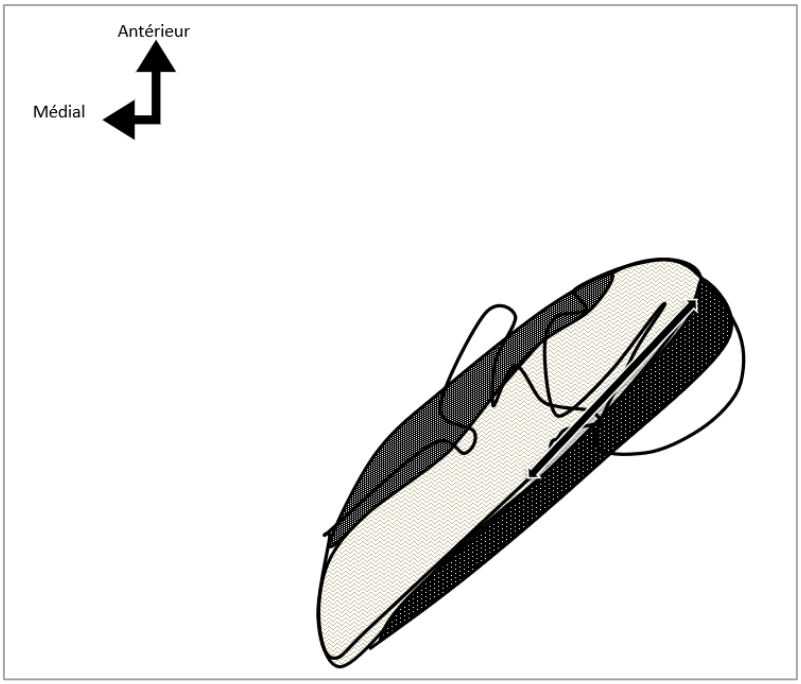
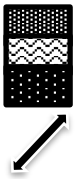


Figure 2. Articular approach via the superoexternal approach by longitudinally incising the posterior musculotendinous portion of the supraspinatus



muscle sous scapulaire
muscle supraspinatus
muscle infraspinatus
incision musculotendineuse postérieure du supraspinatus

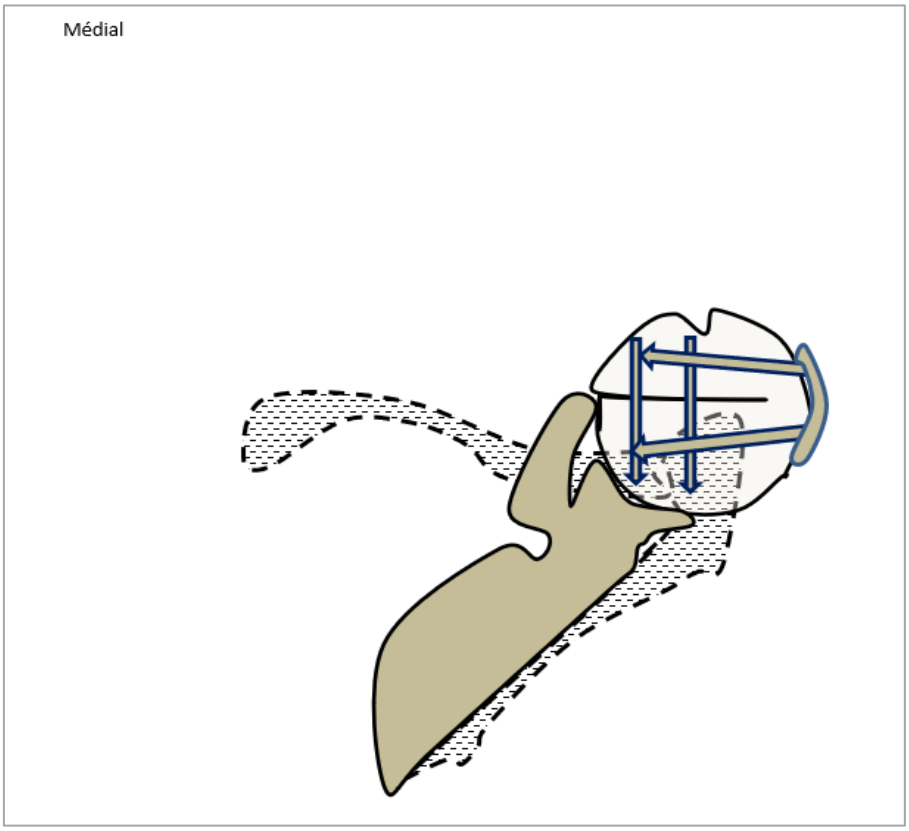


Figure 3: Double anteroposterior epiphyseal screw fixation and lateral screw plate

3. CLINICAL CASE

A 65-year-old right-handed retired man presented to the emergency room following painful impotence of the left upper limb which occurred upon waking in the context of a morpheic convulsive crisis. The physical examination showed significant pain in the left shoulder, anteroposterior edema, limitation of active and passive glenohumeral mobility, particularly in external rotation, no neurovascular abnormality, no brachiothoracic ecchymosis. The shoulder radiographic assessment (Figs. 4 and 5) showed on the anteroposterior view a fracture of the humeral head with disappearance of the glenohumeral joint space and a double contour image of the articular surface suggesting a fracture separation of the humeral head associated with posterior dislocation of the humeral head. The lateral view revealed a widening of the humeral head with tilting and retroversion of the articular surface of the humeral head. The preoperative planning CT assessment of the left shoulder (Fig 6,7,8) confirmed the posterior complex fracture dislocation with 3 fragments. The axial slices and 3D reconstruction images allowed a detailed analysis of the articular fracture of the humeral head impinging on the posterior edge of the glenoid cavity involving more than 50% of the dislocated articular surface (reverse Hill-Sachs lesion) associated with a fracture of the posterior portion of the greater tubercle. Abundant articular hemarthrosis and integrity of the humeral glenoid cavity, scapula and acromion were also noted.

The surgery was performed under general anesthesia, with the patient in a semi-sitting position at approximately 50°. A superolateral approach associated with a double posterior incision was performed. The 3 cm vertical posterior approach with finger discision through the deltoid fibers between the infraspinatus and teres minor muscles aimed to disengage the posterior portion of the humeral head. An attempt at finger reduction was performed as well as the insertion of two 3.5 mm screws in an anteroposterior direction without an articular approach initially. The superolateral approach was performed for osteosuture of the posterolateral fragment of the greater tubercle with Vicryl 2 absorbable thread, the insertion of a 3.5 mm Variax Axos titanium (Stryker) lateral humeral proximal plate with axillary nerve control. Postoperative radiographic control (Fig. 9-10) showed a persistent double contour of the humeral head. The postoperative control CT scan showed incomplete reduction of the articular surface with persistent retroversion of the articular surface of the subluxated humeral head.

Revision surgery was necessary with an articular approach through the superolateral incision allowing direct control of the articular reduction. The rotator cuff was incised longitudinally in the posterior musculotendinous portion of the supraspinatus after analysis of the articular line on CT. The epiphyseal screws of the plate were removed as well as the two 3.5 mm diameter anteroposterior screws to allow for stable reduction and osteosynthesis. A graft extractor was used to assist in reduction of the humeral head by repeating the posterior approach while two 4 mm diameter Stryker autofix screws were inserted in the anteroposterior direction and then an additional screw in the posteroanterior direction. The 3.5mm epiphyseal screws of the plate were placed at the end of the procedure. An intraoperative scopic control was performed at the end of the procedure to check for proper joint reduction and screw positioning. Intraoperative testing showed correct stability of the osteosynthesis. The rotator cuff was sutured with absorbable Vicryl 2 thread with reinforcement on the plate holes. Postoperative immobilization with a 20° abduction cushion was placed for 6 weeks in relation to the healing of the rotator cuff. Self-rehabilitation was initiated postoperatively with pendular movements of the shoulder and mobilization of the elbow. Active rehabilitation sessions were started at six weeks. The postoperative CT control (Fig 11-14) confirmed the correct positioning of the hardware and correct joint reduction. Postoperative radiographic controls at D+1, D+15, 6 weeks, 3 months, 6 months and 10 months showed bone consolidation with correct joint reduction, good positioning of the osteosynthesis hardware. There was no evidence of humeral head necrosis or degenerative signs of the glenohumeral joint. The patient recovered full joint mobility in passive mode in all areas of mobility. In active mode, at the 10th postoperative month, active anterior elevation of 80°, abduction of 90°, external rotation of 10°, and complete internal rotation with complete retropulsion were noted. The patient was pain-free. There was no atrophy of the anterior bundle of the deltoid or axillary nerve disorder noted.

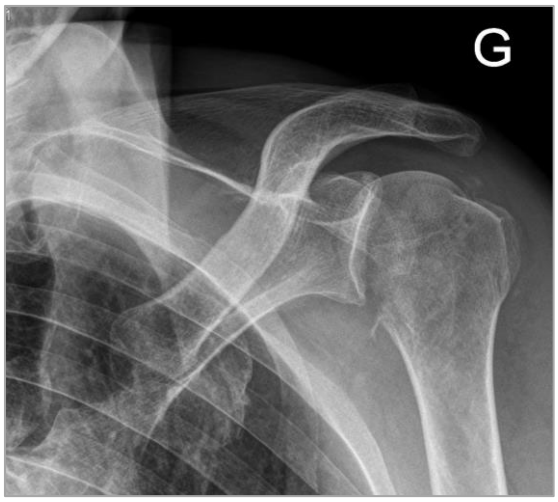


Figure 4: Overlapping of the glenohumeral joint space with double contour of the head strongly suggestive of posterior dislocation of the humeral head

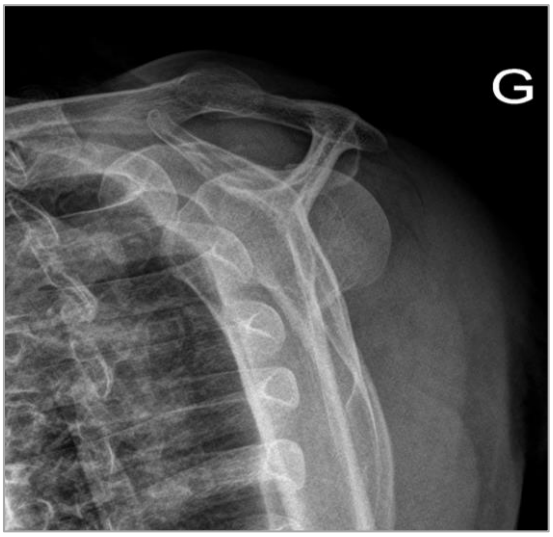


Figure 5: Articular surface of the retroverted humeral head

Figure 6: Confirmation of posterior complex fracture dislocation of the embedded humeral head

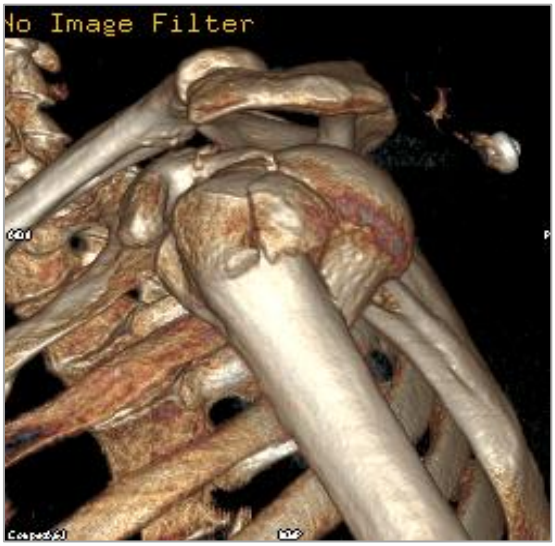


Figure 7: 3D images with posterior fracture of the greater tuberosity

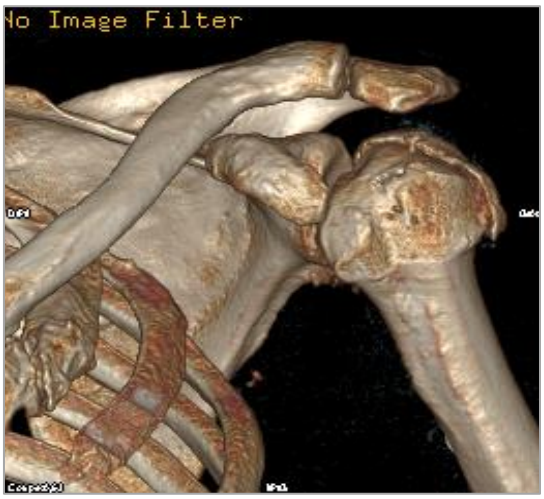


Figure 8: 3D image with "bulb" appearance of the humeral head

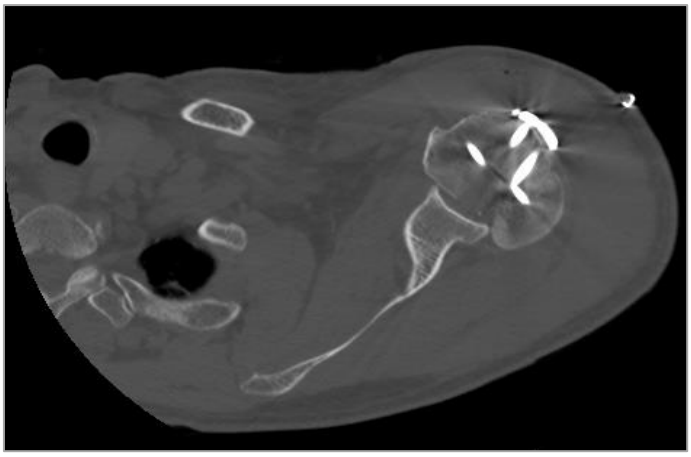


Figure 9: Failure of the first intervention with persistence of the notch and embedding with subluxation of the humeral head.

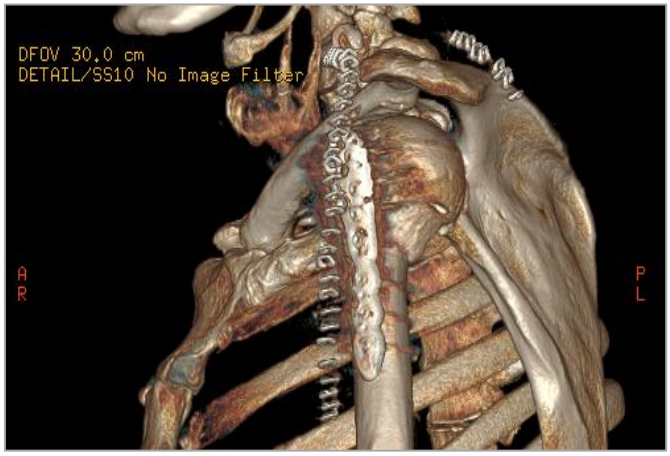


Figure 10: Failure to reduce posterior dislocation with articular surface of the head looking behind the glenoid.

Figure 11 and 12: CT assessment of the shoulder after surgical revision. Hardware in place, satisfactory joint correction.

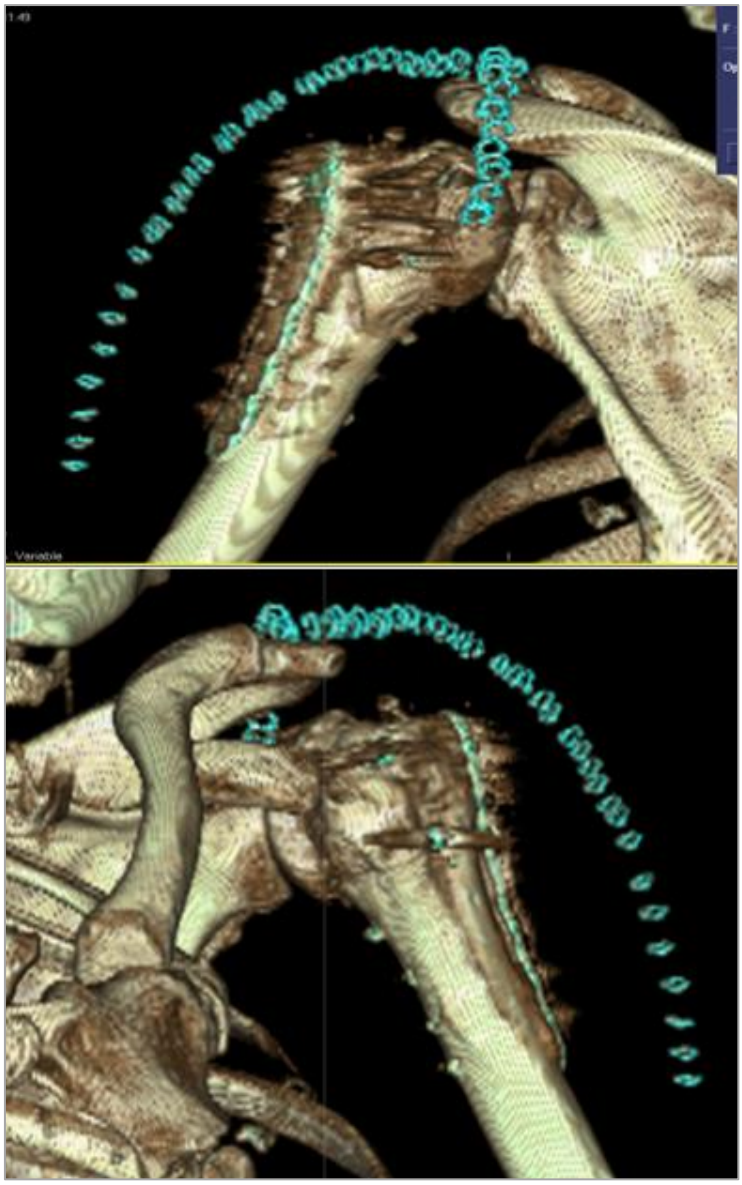


Figure 13-14: 3D visualization of satisfactory correction with hardware in place.

4. DISCUSSION

The anterior deltopectoral approach is the most commonly used approach during shoulder surgery, particularly for fractures of the upper end of the humerus. This approach is particularly suitable in cases of anterior fracture dislocations of the humeral head. In our clinical case, the engagement of the dislocated humeral head behind the glenoid causes internal rotation of the intact lesser tubercle and subscapularis tendon, making access to the articular surface more complex. In the case of a deltopectoral approach, Gokkus *et al*. [6] propose an extensive approach with subperiosteal humeral disinsertion of the supraspinatus and subscapularis tendons. This extensive complete tendon disinsertion allows joint access, but we only recommend it as a last resort. Stableforth *et al* [7] propose a deltopectoral approach with a superior extension extended subacromially, passing transversely from the subacromial joint to extend along the anterior edge of the acromion and ending 4 cm below the lateral edge of the acromion, allowing an approach to the rotator cuff. Fiorentino *et al*. [8] practice a double approach by combining a vertical posterior approach for bone reduction with the anterior deltopectoral approach for positioning the osteosynthesis plate. We do not recommend the deltopectoral approach because visualization of the posterior fracture line can be difficult, requiring forced external rotation, which hinders positioning of the lateral plate, requiring humeral internal rotation. Furthermore, forced external rotation movements can aggravate the fracture line and interfragmentary diastasis.

In our clinical case, we observed the difficulty of controlling the articular fracture line of the posterior part of the humeral head. As with Robinson *et al*. [4], we opted for the lateral transdeltoid approach, which allows joint control and positioning of the lateral plate through a longitudinal approach to the rotator cuff without the need for rotational constraints during temporary

reduction. This approach requires control of the axillary nerve, which is identified and protected during the procedure. However, we have observed a difficulty with this deltopectoral approach alone, in disengaging the reverse Hill Sachs lesion of the humeral head which requires a lateral thrust of the humeral head by manipulating the arm in adduction and a postero-anterior thrust of the humeral head to finish with a gentle external rotation movement. A double posterior approach is very useful to disengage the humeral head and allow sufficient temporary reduction during osteosynthesis. Primary stabilization of the humeral head may require the use of anteroposterior and/or posteroanterior screw fixation. We recommend the use of self-tapping cannulated screws because the use of temporary pins minimizes manipulation. Double-threaded and buried screws are useful for achieving proper compression without hindering the screw head during rotational movements.

Stableforth *et al* (7) described osteosynthesis of posterior humeral head fractures and dislocations by isolated screw fixation of the lateral wall of the humerus toward the humeral head. In our clinical case, we observed significant constraints that led to recurrence or insufficient reduction. Screw fixation of the humeral head fragments provides compression stabilization of the articular fragments but is not sufficient to achieve sufficient rigid fixation. Proximal humeral locking plates currently allow for multidirectional screw fixation of the humeral head with minimal lateral bulk, ensuring correct positioning of the lateral plate height to avoid irritating the subacromial space. Furthermore, the lateral plate allows for suture reinforcement of the rotator cuff through the superior, lateral, and medial holes. Definitive osteosynthesis using pins and nailing appears to be poorly suited for this type of complex humeral head fracture-dislocation.

In our cases, recovery of active range of motion was incomplete. The rotator cuff approach and the start of active rehabilitation at 6 weeks contributed to the incomplete functional outcome. We found here that the rotator cuff approach was necessary because the initial attempt at reduction and osteosynthesis without an articular approach was unsuccessful, requiring surgical revision with direct visualization of the reduction through the cuff approach. Given the posterior fracture line, a more anterior rotator cuff approach is not suitable for controlling the reduction. The start of active mobilization at 3 weeks can be discussed, but given the context of the morpheic epileptic seizure, we favored tendon healing over joint mobilization.

Shoulder arthroplasty may be an alternative, particularly when 50% of the articular surface of the humeral head is affected. Arthroplasty at the age of 65, especially in an epileptic patient, appears to us to be an alternative in the event of failure or impossibility of conservative surgery (non-union, humeral head necrosis, glenohumeral degenerative progression).

5. CONCLUSION

The operative strategy during osteosynthesis of complex posterior interlocked humeral head fractures and dislocations requires a preoperative planning scan. The surgical technique of double superolateral approach with longitudinal incision in the axis of the posterior musculotendinous portion of the rotator cuff allows direct control of the joint reduction associated with a posterior approach for fracture release by gentle manipulation. The optimal non-traumatic reduction as well as the establishment of a stable osteosynthesis by proximal humeral locking plate without forced intraoperative rotational movement allows respect for bone healing and the vitality of the humeral head.

Declaration of interests:

The authors declare that they have no conflicts of interest directly related to this article.

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