

How to manage the failed osteosynthesis in proximal humerus fracture

Laurent Obert¹, Emmanuel Beaudouin², Anyssa Khellafi³, Pascal Clappaz⁴, Séverin Rochet¹, Antoine Adam¹, Roberto Cermeno⁵, Tristan Lascar⁶

¹ University Hospital Besancon
Medical School - University of Bourgogne - Franche Comte – France
chir-ortho-plast-med@chu-besancon.fr

² Hospital of Chambery - France
Emmanuel.Beaudouin@ch-chambery.fr

³ Private Institute of Venissieux “Les pores du Sud” - France
anyssakhellafi@icloud.com

⁴ Private Institute of Bourg en Bresse “Clinique Convert” - France
clappaz@ymail.com

⁵ Hospital general de Segovia - Spain
robcermeno@gmail.com

⁶ Hospital Grace de Monaco - Monaco
tristanlascar@me.com

Corresponding Author
Prof. Laurent Obert MD
Orthopedic, Traumatology, and Hand surgery Unit
University hospital CHRU Besancon
Medical School - University of Bourgogne - Franche Comte
Research Unit : Nano medicine
Bd Fleming 25030 BESANCON France
laurentobert@yahoo.fr
lobert@chu-besancon.fr
00 33 607992784 / 0033 381668285

Introduction : Postoperative complications of fixation by plate or nail of proximal humerus fracture, particularly in the setting of osteoporotic bone, include screw penetration of the articular surface, progressive fracture displacement, and avascular necrosis. Failed internal fixation of a fracture of the proximal humerus produces many challenges with limited surgical options. In case of failed osteosynthesis there is no paper, on our knowledge, focused on the type of solution related to the type of complication.

Fixation by plate and nail : what are the complications ?

When comparing locking intramedullary nailing to ORIF using plates, studies have shown similar results (1,2). Zhu & al compared IM nailing to locked plates in a prospective, randomized trial involving 51 patients who had sustained 2-part surgical neck fractures. Satisfactory results were obtained in both groups with no difference in ASES scores at 3 year follow-up. The complication rate was 31% in the ORIF group compared to 4% in the IM nailing group. Complications included 5 screw tip penetration into the articular surface requiring another surgery.

Sudkamp & al, reported their results of ORIF using a locked plate in 187 patients with 2,3, or 4 part proximal humerus fractures. Their data showed good functional outcomes but was noteworthy for a 40% complication rate with 19% requiring an unplanned second surgery (2).

A retrospective review has been performed on patients older than 18 years of age treated with a locked plate for a proximal humerus fracture (3). 78 proximal humerus fractures in 78 patients were stabilized using a locked plate. Twenty-four patients were lost to follow-up, while 54 patients were available for 6-month minimum follow-up and comprised the study group. An overall complication rate of 37% was found in patients stabilized using a locked plate after sustaining a proximal humerus fracture (3).

The most frequent complication in case of fixation by plate or nail remain the inadequate control of the length of screw (figure 1). in a retrospective study, Egol & al reported 24% complications and 2/3 of these complications were screw penetration (4). In a retrospective study of 252 patients surgically treated for proximal with locking plates, reduction loss occurred in 6.7% (5). Revision surgeries were performed in all cases (figures 2 & 3).

Factors associated with healing complications included increased number of fracture parts, increasing number of comorbidities, and initial

varus malreduction (5). According to Jung & al, older age osteoporosis, varus displacement, medial comminution, reduction adequacy, and insufficient medial support had significant correlations with reduction loss (5).

According to Agudelo & al, avoiding varus should substantially decrease the risk of postoperative failures (6). According to Wu & al early failure of the locking plate is mainly related to the bad reduction during the operation, the loss of medial cortex support, the limitation of screw length, the osteoporosis and the improper rehabilitation after operation (7) (figures 4 & 4 bis). In a recent study (observational, population-based data from all inpatient admissions in California over an eleven-year period with 401 patients) Petrigliano & al reported that intermediate-term reoperations included conversion to hemiarthroplasty in 174 patients (1.5%) and conversion to total shoulder arthroplasty in eight patients (0.07%) (8) (figure 5).

Patient selection for osteosynthesis after proximal humerus fracture should incorporate many factors with meticulous attention to surgical technique.

What are the results of arthroplasty in case of failed osteosynthesis ?

Open reduction and internal fixation (ORIF) of complex fractures of the proximal humerus may yield unsatisfactory results in elderly patient with osteoporotic bone. (figures 6, 6 bis & 6 ter)

In a recent case series Ikram & al reported the use of a locked dedicated hemiarthroplasty to treat 10 cases of failed initial treatment of proximal humerus fracture. The cases of failure of osteosynthesis achieved good results with the uncemented implant (9). (figure 7)

Reverse total shoulder arthroplasty (RTSA) has been shown to be an effective treatment for proximal humerus fracture (PHF) in elderly classified as type C or 3 or 4 part fracture (10). Few studies have analyzed RTSA after failed open reduction with internal fixation (ORIF).

Grubhofer F & al analyzed the results obtained after revision of failed ORIF of proximal humeral fractures using reverse total shoulder arthroplasty (RTSA). Fifty-four shoulders of 53 patients with a subjectively unacceptable outcome after ORIF of a complex fracture of the proximal humerus were revised with RTSA (11). At a minimum follow-up of 2 years (mean follow-up, 46 months; range, 24-108 months), 44 shoulders were clinically and radiographically reviewed. The mean absolute Constant score improved from 26 (range, 4-54) to 55 (19-80) points; the mean relative Constant score improved from 32% (4%-85%) to 67% (27%-94%) of an age- and gender-matched, normal shoulder.

The mean subjective shoulder value improved from 29% (0%-90%) preoperatively to 67% (5%-95%) at final follow-up. Nineteen patients rated their outcome excellent, 16 good, and 7 fair; 2 patients were dissatisfied.

Shannon & al evaluated the outcomes of patients with failed osteosynthesis who undergo salvage RTSA compared with patients undergoing primary RTSA for proximal humeral fractures (12). 18 patients who underwent primary RTSA for acute proximal humeral fractures and 26 patients who underwent arthroplasty after failed ORIF were retrospectively reviewed with a mean follow-up of 3 years (range, 2 -6 years). There were no statistically significant differences in clinical outcomes between the two cohorts in the American Shoulder and Elbow Surgeons scores (ASES) and in the most recent forward flexion or external rotation. The salvage RTSA cohort experienced a higher complication rate (8%), including dislocation and aseptic loosening. The primary RTSA cohort had a 5% complication rate, with 1 late prosthetic joint infection requiring reoperation. Although RTSA after failed ORIF has a higher rate of complications compared with acute RTSA, the revision and reoperation rate as well as clinical outcomes and shoulder function remained comparable (12).

Dezfulli & al reported a series in which 13 patients underwent RTSA for malunion or nonunion and 11 for failed PHF ORIF (13). ER range of motion, SPADI, ASES, UCLA, and Constant scores achieved significance.

the authors concluded that in case of failed ORIF and PHF malunion or nonunion outcomes of revision RTSA are more promising than previously published (13). (figure 8)

While there is now some evidence that RTSA for failed internal fixation in PHF can improve function regarding range of motion (ROM), pain, satisfaction, and strength, there is sparse data how this translates into activities of daily living (ADLs). Maier & al reported the results of a 3D motion analysis system using a novel upper extremity model measured active maximum values and ROM in four ADLs (14). 4 patient with failed ORIF who received RTSA were examined the day before and 1 year after shoulder replacement. If RTSA in revision cases significantly improved maximum active flexion and abduction, the patients were only able to use this greater ROM to their benefit in one of four ADLs. Only three additional tasks of the ADL (out of 13/24 preoperatively) could be performed after revision surgery (14).

Conclusion :

Intraoperative techniques to enhance the fixation construct and reduce complications include use of rotator cuff sutures, bone void fillers (fibular strut allograft, cancellous allograft, autograft, bone cement), appropriate placement of divergent and shorter locking screws, and medial calcar reduction and support. The use of these strategies may reduce the most frequent complications after plating or nailing of osteoporotic proximal humerus fractures which are screw penetration and loss of reduction. Hemiarthroplasty can be proposed in case of early posttraumatic arthritis or necrosis if cuff is intact. In case of late symptomatic complication with a painful stiffness shoulder (necrosis, malunion, iatrogenic cuff tear), RTSA remain the appropriate solution after eliminating a septic complication.