

## PROXIMAL HUMERAL FRACTURE FIXATION TECHNIQUES – CRITICAL ANALYSIS

Piotr Kominiak

Orthopaedic Department, Dom Lekarski S.A. Medical Centre, Szczecin, Poland

### SUMMARY

#### Introduction

Proximal humeral fracture (PHF) is the third most common type of fracture behind distal radius and proximal femur. There is a huge increase in operations due to proximal humeral fracture, mainly open reduction and internal fixation and reverse total shoulder prostheses. The problem is that fixation management has not yet been standardized.

#### Aim

The questions are: can we really achieve the aim of the treatment by fixing the proximal humeral fracture? Do we have support in the literature? Should we fix this fracture so often?

#### Material and methods

There are many publications relating to different types of PHF fixation in the PubMed, including “positive” studies, in which the authors in their conclusions encourage us to treat our patients surgically and “negative” studies, in which the authors discourage us from doing fixation. This present analysis is focused on the rate of complication.

#### Results

If we precisely analyze articles for the number of complications, we see that they are at about 40% and even very experienced surgeons who do this kind of surgery on a daily

## TECHNIKI ZESPOLENIA ZŁAMAŃ PROKSYMALNYCH KOŚCI RAMIENNEJ – KRYTYCZNA ANALIZA

Piotr Kominiak

Klinika Ortopedii, Dom Lekarski S.A. Centrum Medyczne, Szczecin, Polska

### STRESZCZENIE

#### Wprowadzenie

Bliższe złamanie kości ramiennej (PHF) jest trzecim najczęściej występującym typem złamania oprócz dystalnej części kości promieniowej i bliższej części kości udowej. Obecnie rejestruje się znaczący wzrost operacji ze względu na proksymalne złamanie kości ramiennej, głównie poprzez otwartą redukcję i wewnętrzną stabilizację oraz całkowite odwrócone protezowanie ramion. Problem polega na tym, że leczenie zespoleniami nie zostało jeszcze ustandaryzowane.

#### Cel

Pytania postawione w tej pracy brzmią: czy naprawdę możemy osiągnąć cel leczenia, stosując zespolenie złamania bliższego końca kości ramiennej? Czy jest opis skuteczności tego w literaturze? Czy powinniśmy tak często naprawiać to złamanie?

#### Materiał i metody

Istnieje wiele publikacji związanych z różnymi rodzajami zespolenia PHF w PubMed, w tym badania „pozytywne”, w których autorzy w swoich wnioskach zachęcają nas do leczenia pacjentów operacyjnie i „negatywne”, w których autorzy zniechęcają nas do wykonywania zespolień. Niniejsza analiza koncentruje się na tempie komplikacji towarzyszącej leczeniu PHF.

#### Wyniki

Jeśli dokładnie analizujemy artykuły pod kątem liczby powikłań, widzimy, że wynoszą one około 40%, a nawet bardzo doświadczeni chirurdzy, którzy codziennie wykonują

basis are able to achieve a complication rate of about 20%, which is still a large number.

If we examine the literature for the comparison of outcomes following fixation and conservative treatment, we do not find significant differences between the operative and non-operative treatment, but we can find conclusions that that operative treatment is an independent risk factor for inpatient adverse events and mortality in older patients admitted to the hospital with isolated proximal humeral fracture.

### Conclusions

When we analyse the data for rates of complication, we see that the results following proximal humeral fracture fixation are not as good as we would wish, so we should more often think not how we should fix the fracture but if we really should fix the fracture?

**Keywords:** proximal humeral fractures, fixation, complications

*Date received: 15th January 2018*

*Date accepted: 10th February 2018*

### Introduction

Proximal humeral fracture is the third most common type of fracture behind distal radius and proximal femur. In most cases it affects older patients (over the age of fifty), with the incidence increasing over the following three decades (Jost *et al.*, 2013). Women are affected twice as often as men as a result of osteoporosis (Neuhaus *et al.*, 2014). In 2017, Sabesan evaluated trends and variations in treatment methods for proximal humeral fracture (PHF) in the United States from 2004 to 2012, and he identified 550.116 PHF discharges. During this time there was a huge increase in operations due to proximal humeral fracture, mainly open reduction and internal fixation and reverse total shoulder prostheses. Yet the most important conclusion from this

tego rodzaju operacje, są w stanie osiągnąć współczynnik komplikacji wynoszący, około 20%, który wciąż jest dużą liczbą.

Jeśli przeanalizujemy literaturę w celu porównania wyników po zespoleniu i leczeniu zachowawczym, nie stwierdzimy znaczących różnic między leczeniem operacyjnym i nieoperacyjnym, ale możemy znaleźć wnioski, że to leczenie operacyjne jest niezależnym czynnikiem ryzyka dla zdarzeń niepożądanych w warunkach szpitalnych i wpływa na umieralność u starszych pacjentów przyjmowanych do szpitala z izolowanym złamaniem bliższego końca kości ramiennej.

### Wnioski

Kiedy analizujemy dane pod kątem częstości występowania powikłań, widzimy, że wyniki po zespoleniu złamania bliższego końca kości ramiennej nie są tak dobre, jak byśmy sobie życzyli, więc powinniśmy częściej zastanawiać się, jak naprawić złamanie, ale czy naprawdę powinniśmy to robić?

**Słowa kluczowe:** złamania proksymalne kości ramiennej, zespolenie, komplikacje

*Data otrzymania: 15 styczeń 2018*

*Data zaakceptowania: 10 luty 2018*

study is the projection trend that we will do more and more PHF surgeries, employing in particular open reduction and internal fixation and reverse total shoulder prostheses (Oval and Tuckermann, 2016).

The aim of fixation is to reduce the fracture, to restore the anatomy, which should restore function as much as possible, and to minimise pain. The problem is that fixation management has not yet been standardised. There are different kinds of fracture classification, different surgical approaches and different kinds of fracture fixation and we do not yet know which option is the best for a particular patient.

Another problem is that most of these fractures are treated in small centres, where the

surgeons perform fewer than 10–15 proximal humeral operations per year, so they do not have enough practice at this kind of surgery.

### Aim

The questions in this review are: can we really achieve the aim of the treatment by fixing the proximal humeral fracture? Do we have support in the literature? Should we fix this fracture so often?

### Material and methods and results

#### *Literature review for outcomes following fixation*

There are many publications relating to different types of PHT fixation in the PubMed, including „positive” studies, in which the authors in their conclusions encourage us to treat our patients surgically and „negative” studies, in which the authors discourage us from performing fixation. This present analysis is focused on the rate of complication.

Goch compared the outcomes for proximal humeral fracture fixations in younger (aged 55–69) and older patients (aged over 70) but he did not find any differences, so this means that we can successfully repair fractures even in older patients. However, when we analyze this data according to the rate of complications, it was quite high in both groups – 17% in the younger group and 21% in the older group (Castoli *et al.*, 2015). In another prospective, multicenter observational study, Südkamp analyzed 187 patients treated with open reduction and internal fixation using a locking proximal humerus plate. He concluded that this kind of treatment can lead to good functional results if the correct surgical technique is used. Unfortunately, the complication rate was 34%, which was mainly related to incorrect surgical technique. These results show how difficult it is to achieve the correct surgical technique since in one third of the cases it was not possible. (Sohn *et al.*, 2017) The next „positive” study is Schnetzke’s description. He reports that following an anatomical or acceptable reduction of the fracture, the complication

rate was 20% compared to 41% in those for whom the reduction was unacceptable. He concluded that anatomical fracture reduction and locked plate fixation significantly improved clinical outcomes. However, the first problem with this conclusion is that anatomical or acceptable reduction of the fracture was achieved in only 40.8% of patients, so almost 60% had neither anatomical nor acceptable fracture reduction. The second problem is that even if we achieve good fracture reduction the complication rate is 20%, so still quite high. (Sabesan *et al.*, 2017) In another study Shon compared an open-plating technique with a minimally-invasive plate osteosynthesis and the main conclusion of this study was that the minimally-invasive plate osteosynthesis technique has similar clinical and radiographic outcomes compared to the open technique but the time of surgery was shorter. But again, if we look at the complication rate, it was still quite high for both techniques – 35% for MIPO and 40% for ORIF (Schnetzke *et al.*, 2016).

Despite these problems, all is not lost for open reduction and internal fixation, because if our fixation fails we still can perform the next procedure: reverse total shoulder arthroplasty. Gerber carried out a study in which he evaluated results following reverse total shoulder arthroplasty performed due to failure in the open reduction and internal fixation. He analyzed 53 patients (54 shoulders), who had revision surgery with reverse total shoulder prostheses, due to unacceptable outcomes following open fixation. The results were not so good: 19 excellent, 16 good, 7 fair, 2 unsatisfactory (Goch *et al.*, 2017). In another study Gerber analyzed patients who had been referred to his institution because of complications following open reduction and internal fixation. Between 2003 and 2010 there were 121 patients. He divided these into non – implant complications and plate complications.

Non – implant complications:

- malreduction – 67 patients (55%),
- primary screw cut-out – 14 patients (12%),

- malunion – 76 patients (63%),
  - nonunion – 16 patients (13%),
  - AVN – 82 patients (68%),
  - infection – 5 patients (4%),
- Implant complications:
- secondary screw cut-out – 69 patients (57%),
  - glenoid destruction – 40 patients (33%).

Only 14 (12%) of these patients were treated conservatively and 107 (88%) had to be treated by revision surgery. Gerber concluded that in all likelihood the reasons for these complications were:

- an extended indication for open reduction and internal fixation (more than 50% of these patients had 4-part fractures and more than 20% had head split or fracture with dislocation),
- failure to recognize an avascular necrosis risk (more than 80% of the patients did not have metaphysical connection),
- failure to recognize the surgeon's limitations (more than 50% of patients did not have an anatomic reduction of the fracture) (Handoll *et al.*, 2017).

So if we precisely analyze all these articles for the number of complications, we see that they are at about 40% and even very experienced surgeons who do this kind of surgery on a daily basis are able to achieve a complication rate of about 20%, which is still a large number.

If we examine the literature for the comparison of outcomes following fixation and conservative treatment, we may be surprised. Handoll (2017) published a randomised clinical trial in which he compared the five-year follow-up results of the operative and non-operative treatment of adults with a displaced fracture of the proximal humerus. He evaluated 176 patients and there were no statistically or clinically significant differences between the operative and non-operative treatment at each follow-up point. No participant had secondary surgery for a new complication (Grubhofer *et al.*, 2017). Neuhaus (2014) compared outcomes following operative and conservative treatment

for isolated proximal humeral fracture using a large national database representing 132.005 patients aged 65 or older. He concluded that operative treatment is an independent risk factor for inpatient adverse events and mortality in older patients admitted to the hospital with isolated proximal humeral fracture (Kannus *et al.*, 2000).

#### *Decision making process*

So before we make the final decision as to what kind of treatment we will perform, we should try to understand the fracture depending on:

- the patient's age and requirements,
- fracture patterns such as: integrity of calcar and medial hinge, degree of tuberosity displacement, head impaction (valgus/varus), displacement of humeral shaft, head splitting or glena-humeral dislocation, bone quality,
- available equipment for fixation,
- the surgeon's skills and experience (Aigner *et al.*, 2004)

Careful analysis of the fracture is extremely important because:

“The first shot is the best shot”. This means that the treatment of proximal humeral fracture sequela is very difficult and the outcomes are poor.

#### **Conclusions**

1. We do not have any classification which allows us to associate a type of fracture to a single type of treatment.
2. Before we make the final decision as to what kind of fixation we will use, we should try to understand the fracture, because „the first shot is the best shot”.
3. The most important question is not HOW I should fix the fracture but IF I should fix the fracture?
4. Proximal humeral fracture fixation should not be an emergency procedure. We should take the time to take precise radiographic pictures, to plan the treatment and if we decide to perform surgery we should prepare an experienced op-team and choose

the best surgical instrumentation (pins, dedicated plates, bone graft, shoulder prosthesis).

5. There are lots of options for fixation – this means we still do not have the ideal option.
6. When we analyze the data for rates of complication, we see that the results following proximal humeral fracture fixation are not as good as we would like.
7. We should remember that there are a lot of factors influencing our results, such as:
  - type of fracture,
  - patient's age and requirements,
  - bone quality,
  - available equipment for fixation,
  - the surgeon's skills and experience.



## REFERENCES

- Aigner, F., Longato, S., Fritsch, H., Kralinger, K.** (2004) 'Anatomical considerations regarding the "bare spot" of the glenoid cavity.' *Surg Radiol Anat.*, 26, pp. 308–311.
- Castoli F. et al.** (2015) 'Simple and Complex Fractures of the Humerus.' Springer-Verlag Italia.
- Goch A.M., Christiano A., Konda S.R., Leucht P., Egol K.A.** (2017) 'Operative repair of proximal humerus fractures in septuagenarians and octogenarians: Does chronologic age matter?' *J Clin Orthop Trauma.*, 8(1):50–53.
- Grubhofer F., Wieser K., Meyer D.C., Catanzaro S., Schürholz K., Gerber C.** (2017) 'Reverse total shoulder arthroplasty for failed open reduction and internal fixation of fractures of the proximal humerus.' *J Shoulder Elbow Surg.*, Jan;26(1):92–100.
- Handoll H. H., A. Keding, B. Corbacho, S. D. Brealey, C. Hewitt, A. Rangan** (2017) 'Five-year follow-up results of the PROFHER trial comparing operative and non-operative treatment of adults with a displaced fracture of the proximal humerus.' *Bone Joint J.*, 99 – B:383–92.
- Jost B., Spross C., Grehn H., Gerber C.** (2013) 'Locking plate fixation of fractures of the proximal humerus: analysis of complications, revision strategies and outcome.' *J Shoulder Elbow Surg.*, Apr;22(4):542–9.
- Kannus P., Palvanen M., Niemi S., Parkkarij, Jarvinen M., Vuori I.** (2000) 'Osteoporotic fractures of the proximal humerus in elderly Finnish persons: sharp increase in 1970–1998 and alarming projection for the new millennium.' *Acta Orthop Scand.*, 71:465–470.
- Neuhaus V., Bot A.G., Swellengrebel CH., Jain N.B., Warner J.J., Ring D.C.** (2014) 'Treatment choice affects inpatient adverse events and mortality in older aged inpatients with an isolated fracture of the proximal humerus.' *J Shoulder Elbow Surg.*, 2014 Jun;23(6):800–6.
- Oval Kj., Tuckermann J.D.** (2006) 'Handbook of fractures, 3rd edn.' Lippincot Williams & Wilkins, Philadelphia.
- Sabesan V., Lombardo D., Petersen-Fitts G., Weisman M., Ramthun K., Whaley J.** (2017) 'National trends in proximal humerus fractures treatment patterns.' *Aging Clinical and Experimental Research.* December, Vol. 29, Issue 6, pp1277–1283.
- Schnetzke M., Bockmeyer J., Porschke F., Studier-Fischer S(1), Grützner P.A., Guehring T.** (2016) 'Quality of Reduction Influences Outcome After Locked-Plate Fixation of Proximal Humeral Type-C Fractures.' *J Bone Joint Surg Am.*, 2016 Nov 2;98(21):1777–1785.
- Sohn H.S., Jeon Y.S., Lee J., Shin S.J.** (2017) 'Clinical comparison between open plating and minimally invasive plate osteosynthesis for displaced proximal humeral fractures: A prospective randomized controlled trial.' *Injury.* Jun;48(6):1175–1182.
- Südkamp N., Bayer J., Hepp P., Voigt C., Oestern H., Kääh M., Luo C., Plecko M., Wendt K., Köstler W., Konrad G.** (2009) '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.*, Jun;91(6):1320–8.

*Author reported no source of funding.  
Author declared no conflict of interest.*

*Autor nie zgłosił źródła finansowania.  
Autor nie deklarował konfliktu interesów.*

*Author responsible for correspondence:  
Piotr Kominiak  
Orthopaedic Department  
Dom Lekarski S.A. Medical Centre  
ul. Rydla 37  
70-783 Szczecin  
pkominiak@domlekarski.pl*

*Autor odpowiedzialny za korespondencję:  
Piotr Kominiak  
Klinika Ortopedii  
Dom Lekarski S.A. Centrum Medyczne  
ul. Rydla 37  
70-783 Szczecin, Polska  
pkominiak@domlekarski.pl*