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**ARTHROSCOPIC TREATMENT OF PROXIMAL HUMERAL FRACTURES**

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SUMMARY
According to the previous descriptions, the arthroscopic treatment of proximal humeral fractures is a promising and effective, however demanding technique. The use of cannulated screws, suture anchors and their combination enhanced with the possibilities of arthroscopic visualization provide new, broader possibilities in treatment of proximal humeral fractures. The successful treatment of comminuted Neer IV (1970) fractures requires a presence of either preserved or locked surgical neck of the humerus (Taverna *et al.* 2004). This report presents own experiences of author on usage of this type of surgery in discussion to the papers on the topic.

**Keywords:** proximal humeral fractures, arthroscopy

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**LECZENIE ARTROSKOPOWE ZŁAMAŃ BLIŻSZEGO KOŃCA KOŚCI RAMIENNEJ**

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STRESZCZENIE
Zgodnie z poprzednimi doniesieniami, leczenie artroskopowe proksymalnych złamań kości ramiennej jest obiecującą i skuteczną, jednak wymagającą techniką. Zastosowanie kaniulowanych śrub, szwów i kotwic a także ich kombinacji wzbogacone o możliwości artroskopowej wizualizacji zapewniają nowe, szersze możliwości w leczeniu złamań bliższego końca kości ramiennej. Skuteczne leczenie wielofragmentowych złamań typu Neer IV (1970), wymaga zachowania szyjki kości ramiennej lub jej zaklinowanego złamania. (Taverna i wsp. 2004). Niniejsze doniesienie przedstawia własne doświadczenia autora w wykorzystaniu tego typu operacji w odniesieniu do poglądów wyrażonych w innych praca na ten temat.

**Słowa kluczowe:** złamania bliższego końca kości ramiennej, artroskopia

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## Introduction

Arthroscopic treatment of proximal humeral fractures is widely used technique, however, to date few studies were published on this subject. Most of them report the results of treatment of the greater tuberosity isolated fractures. In this study, there are also presented patients treated for comminuted fractures of the greater tuberosity and isolated fractures of the lesser tuberosity. The arthroscopic treatment of fractures in this area was first reported by Taverna *et al.* (2004). According to Bigliani *et al.* (1998), fractures of the greater tuberosity displaced by more than 5 mm should be treated surgically to avoid the subacromial impingement and limitation of abduction

and internal rotation. In study of Park *et al.* (1997), they decreased this limit to 3 mm and in study of Lorenz *et al.* (2012) it was diminished to 2 mm.

**Aim**

This report presents own experiences of author on usage of this type of surgery in discussion to the papers on the topic.

**Materials and methods**

Twenty three patients were treated by two experienced surgeons (RB, AB) for the proximal humeral fractures between 2008 and 2014. Study group consisted of 18 men and 5 women, the patients with the proximal humeral fracture without a rotator cuff tear. Mean age at the time of surgery was 48 (age range from 18 to 71 years). Mean time from fracture to surgery was 6.65 months (from 0.5 to 31 months). Mean follow-up period was 11.1 months (from 1.5 to 64 months) Range of motion was assessed at the last follow-up. Preoperative evaluation of range of motion was not possible due to the tenderness of the shoulders after the trauma.

There were 18 cases of greater tuberosity fracture, one lesser tuberosity fracture, two fractures of both tuberosities (Figure 1), and two fractures of both tubercles combined with the surgical neck fracture.

Six patients were treated for simple fractures and 17 for comminuted fractures of the greater tuberosity. All patients were operated in beach-chair position. All arthroscopic repair was performed in all cases, with no requirement for conversion to the open surgery. Metal cannulas were used while inserting the cannulated screws. Suture anchors and arthroscope were inserted into the extracapsular space without cannulas. Three methods were used for fracture fixation: cannulated titanium screws, suture anchors or combination of the two previous. The third method is an own modification that takes advantage of interconnecting anchors and screws with the sutures. Cannulated screws were used in patients with simple or two-fragment fractures. In cases of comminuted tubercle fractures, the suture anchors were used.

*Surgical technique*

The lateral portal was used to insert the arthroscope in cases of comminuted fractures to avoid further iatrogenic translation and fragmentation. After the lateral portal was assessed, the antero-lateral and postero-lateral portals were performed and a switching stick was inserted to elevate the deltoid. After the evacuation of blood clots (Figure 2) and lavage of hematoma, a bursectomy was performed in order to

**Figure 1.** X-ray presenting fractures of both tubercles.

identify the humeral shaft and fracture fragments. Long head of biceps was evaluated and if it was necessary, tenodesis or tenotomy were performed.

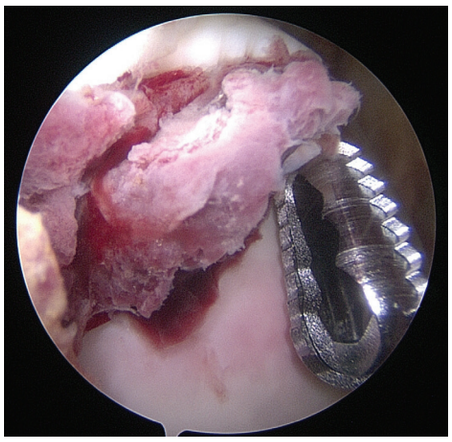

**Figure 2.** An endoscopy photograph presenting blood clot.

In cases where significant fragment translation was encountered, fragments were temporarily repositioned and stabilized with K wires. The rotator interval was opened to visualize the joint. In cases of intraarticular fractures, the fragments with cartilage were first reduced and stabilized (Figure 3).

After their temporary stabilization, other fragments were reduced and their extracapsular position was controlled. If vertical fissure was observed, the larger fragment was stabilized with a cannulated screw, and smaller with a suture anchor passing through the fragment into the humeral metaphysis. The suture from the anchor was tied around the screw neck thus compressing the fissure (Figure 4).

After confirming the fixation stability, a positon of fracture fragments and implants was controlled with the intraoperative X-ray. In cases where both of the fragments were large enough, each were fixed to the shaft with a cannulated screw. The fixation was often complemented with a suture anchor placed below the screws and sutures tied around the screws' necks.

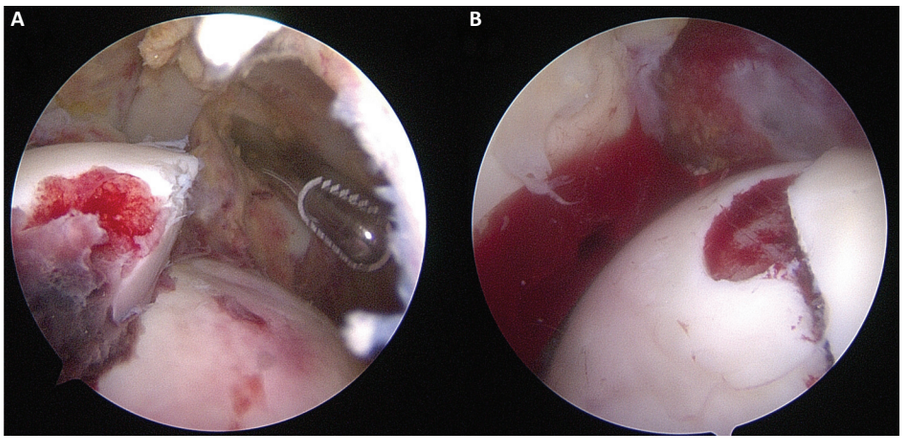


**Figure 3.** The endoscopy photographs presenting (A) preoperative reduction, (B) postoperative reduction.

Posterior portal was used to begin the arthroscopy in cases with the fractures of the lesser tuberosity or minor fragments of the greater tuberosity. Preparation of the surface of the fracture fragments and their

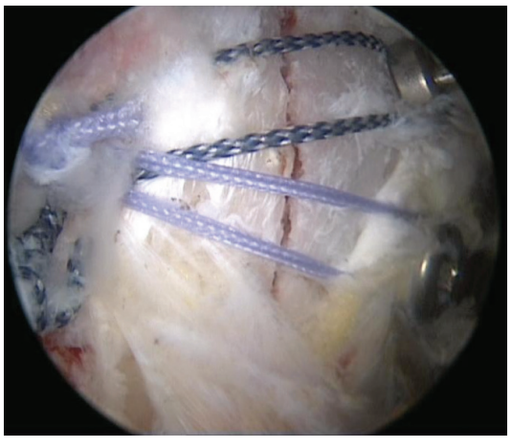

**Figure 4.** An endoscopy photograph presenting the anchor suture and bridged screws.

reposition were performed while keeping the arthroscope inside the joint. Stabilization of the lesser tuberosity was continued outside of the capsule with the arthroscope inserted through antero-lateral portal. In situations where the size of the fractured lesser tuberosity was large enough, fixation was performed using cannulated screw (Figure 5).

Then a titanium suture anchor was placed laterally to the screw and sutures were passed through the subscapularis tendon.

During postoperative care, a shoulder was secured with adduction sling and swathe for 4–6 weeks. The passive elbow flexion and extension were applied since the second day post-surgery. The passive abduction, rotation and pendular exercises were applied from 4th week postoperatively within painless range of motion.

**Results**

Mean number of anchors used in the surgeries was 1.64 (range from 0 to 3). In 3 cases one or two cannulated screws were used and in 4 cases combination of anchors and screws was applied.

Mean range of motion at the last follow-up was 159° for forward flexion, 91.5° for abduction, L1 for internal rotation and 43.3° for external rotation. The full fracture union was achieved in all cases. Detailed data is presented in Table 1.

Abbreviations: G-Gender (Male, Female), S-shoulder (Left, Right), T-Tuberosity (G-Greater, L-Lesser), D-Dislocation (Yes, No), FU-Follow up period (months), VAS-visual analog scale score, ROM-range of movement (FF-flexion forward, ABD-abduction, IR-internal rotation, ER-external rotation), A-number of anchors, Sc-number

**Figure 5.** An endoscopy photograph presenting the lesser tuberosity affixed with a cannulated screw.

**Table 1.** Patients demographic data and the postoperative outcomes

| | | | | | | | | ROM | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No** | **G** | **Age** | **S** | **T** | **D** | **FU** | **VAS** | **FF** | **ABD** | **IR** | **ER** | **A** | **Sc** | **TFTS** | **AT** |
| 1 | M | 68 | L | G | N | 6 | 1 | 180 | 90 | L1 | 45 | 3 | 0 | 3 | Peek |
| 2 | M | 59 | R | G | Y | 64 | 0 | 160 | 90 | L1 | 25 | 3 | 0 | 13 | Titanium |
| 3 | F | 53 | R | G | Y | 18 | 1 | 170 | 90 | L1 | 55 | 2 | 0 | 19 | Peek |
| 4 | M | 40 | R | G | N | 6 | 3 | 140 | 90 | L3 | 40 | 2 | 0 | 1.25 | Peak |
| 5 | M | 52 | R | G | N | 12 | 0 | 180 | 110 | Th12 | 70 | 2 | 0 | 6 | Titanium |
| 6 | M | 71 | L | G | Y | 18 | 1 | 170 | 80 | L1 | 60 | 1 | 2 | 0.5 | Titanium |
| 7 | M | 65 | R | G | Y | 2 | 3 | 70 | 30 | L-S | 20 | 2 | 0 | 8 | Titanium |
| 8 | M | 35 | L | G | N | 3.5 | 0 | 180 | 100 | L1 | 50 | 0 | 2 | 0.25 | |
| 9 | F | 18 | L | G | Y | 5 | 0 | 180 | 120 | Th12 | 80 | 2 | 0 | 0.75 | Peek |
| 10 | M | 35 | L | L + G | Y | 12 | 1 | 175 | 100 | Th10 | 50 | 2 | 0 | 1 | Peek/Titanium |
| 11 | M | 45 | R | L | Y | 12 | 0 | 170 | 110 | L-S | 70 | 1 | 1 | 13 | Titanium |
| 12 | M | 50 | L | G | N | 12 | 0 | 175 | 100 | L1 | 15 | 2 | 0 | 6 | Peek |
| 13 | M | 44 | L | L + G | N | 34 | 0 | 180 | 120 | Th11 | 40 | 0 | 2 | 0.25 | |
| 14 | M | 61 | L | G | Y | 5 | 2 | 170 | 80 | Th11 | 15 | 3 | 0 | 4 | Titanium |
| 15 | M | 54 | R | G | Y | 12 | 1 | 170 | 110 | Th8 | 45 | 2 | 0 | 9 | Titanium |
| 16 | F | 45 | L | G | Y | 1.5 | 4 | 45 | 30 | L-S | 15 | 0 | 2 | 0.25 | |
| 17 | F | 61 | L | G | N | 3 | 2 | 160 | 85 | Th12 | 20 | 2 | 0 | 4 | Titanium |
| 18 | M | 30 | L | G | Y | 4.5 | 1 | 180 | 110 | Th9 | 85 | 1 | 2 | 0.25 | Titanium |
| 19 | M | 35 | R | G | N | 1.5 | 1 | 180 | 90 | Th12 | 45 | 1 | 0 | 20 | Titanium |
| 20 | F | 49 | L | G | N | 12 | 0 | 180 | 120 | Th6 | 30 | 2 | 0 | 1 | Titanium |
| 21 | M | 51 | R | G | N | 6.5 | 1 | 170 | 90 | Th12 | 35 | 2 | 0 | 31 | Titanium |
| 22 | M | 32 | L | L + G | N | 2.5 | 1 | 165 | 90 | L2 | 45 | 1 | 2 | 11 | Titanium |
| 23 | M | 62 | L | L + G | N | 3 | 1 | 110 | 70 | L2 | 40 | 1 | 2 | 0.5 | Titanium |

of screws, TFTS-time from trauma to surgery in months, AT-anchor type.

## Discussion

The most important finding of this study is that arthroscopy provides many possibilities of treatment of fractures around the proximal humerus. Not only where it refers to the isolated greater tuberosity fractures but also in cases of more complex comminuted fractures, fractures of lesser tuberosity and locked humeral surgical neck fractures. Arthroscopy is also a helpful tool in the treatment of nonunions, pseudoarthroses of humeral tuberosities (Figure 6).

Even markedly retracted fracture fragments can be reduced with the use of arthroscopic technique. The reduction of the fragments becomes possible through the arthroscopic capsulotomy, and their fixation can be performed without excessive tension to the soft tissues.

In this study, in two cases of deferred operations of comminuted four-fragment fractures, the mobilization, reduction and fixation of both greater and lesser tubercle were possible without undesirable unwedging of the humeral shaft and humeral head with joint surface.

In both cases of locked surgical neck fractures, the shaft was stable in the

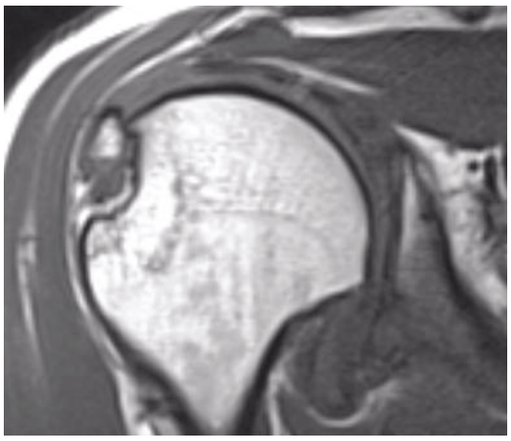

**Figure 6.** A computer tomography picture presenting pseudoarthrosis of the greater tuberosity.

intraoperative X-ray and didn't require the additional stabilization (Figure 7).

Contrary to the previous reports (Lee *et al.* 2012), authors consider the use of relatively thin (3.2 mm J & N Latarjet) screws which are sufficient and safe. In case of osteoporotic bone, the fixation can be complemented with a cerclage thread from the anchor placed in the humeral shaft. This method becomes very useful in treatment of comminuted fractures of both humeral tubercles. Along with the successful report on this kind of treatment by Pauly *et al.* (2013), our study resulted in regaining of a full functionality in all cases of patients.

## Conclusions

Arthroscopy is a powerful tool in the treatment of proximal humeral fractures. It allows the precise reduction and sufficient fixation of fracture fragments. Furthermore, the concomitant lesions of soft tissues can be managed concurrently.

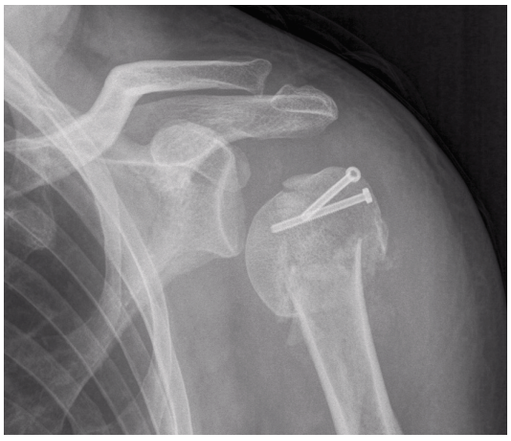

**Figure 7.** X-ray presenting the concomitant locked surgical neck fracture

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