Case report
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Reverse Shoulder Arthroplasty After Communited Humerus Fracture: A Case Report

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Background. Fractures of the proximal humerus are common injury, especially among older age group patients. For the treatment of most cases, conservative tactics are required, some require surgery: osteosynthesis, arthroplasty. Proximal humerus fractures with extension to the metadiaphyseal and diaphyseal zones uncommon, and treatment of this type of injuries is complex for trauma surgeons.
The aim of the study is to demonstrate successful experience of two-stage treatment of the proximal humerus fracture with extension to the diaphysis middle third in an older age group patient.
Case presentation. The case report presents successful two-stage treatment of the proximal humerus fracture with extension to the middle third of the diaphysis in an older age group patient. The first stage was performed osteosynthesis of the humerus with the PHILOS Long plate, the second stage — reverse shoulder arthroplasty.
Conclusion. Consistent performing of osteosynthesis and total reverse shoulder arthroplasty allows to achieve satisfactory treatment results with restoration of the injured limb function and relief of pain syndrome.

Keywords: humerus fracture, plate osteosynthesis, shoulder arthroplasty, humerus head avascular necrosis.

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Реверсивное эндопротезирование плечевого сустава после оскольчатого перелома плечевой кости: клинический случай

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Актуальность. Переломы проксимального отдела плечевой кости — распространенная травма, особенно среди пациентов старшей возрастной группы. Для лечения большинства данных повреждений применяется консервативная тактика, однако некоторым пациентам требуется хирургическое лечение: остеосинтез, эндопротезирование. Переломы проксимального отдела плечевой кости с распространением на метадиафизарную и диафизарную зоны встречаются значительно реже, и их лечение представляет сложную задачу для травматологов.

Описание случая. Представлен успешный опыт двухэтапного лечения перелома проксимального отдела плечевой кости с распространением до средней трети диафиза у пациентки старшей возрастной группы. Первым этапом выполнен остеосинтез плечевой кости пластиной PHILOS Long, вторым этапом — реверсивное эндопротезирование плечевого сустава.

Заключение. Последовательное применение остеосинтеза и тотального реверсивного эндопротезирования плечевого сустава позволяет добиться удовлетворительных результатов лечения с восстановлением функции травмированной конечности и купированием болевого синдрома.

Ключевые слова: перелом плечевой кости, остеосинтез пластиной, эндопротезирование плечевого сустава, аваскулярный некроз головки плечевой кости.

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BACKGROUND

Proximal humerus fractures (PH) represent the third most common injury among geriatric patients [1, 2]. Generally, such fractures are associated with osteoporosis, and low-energy injuries can lead to complex types of fractures in this area [3]. In most cases, a conservative approach is used to treat such fractures, but surgical stabilization is required in some cases according to classical indications using intramedullary or plate osteosynthesis [3]. The main treatment objectives geriatric patients with PH fractures are early rehabilitation and rapid daily activity resumption [4]. However, PH fractures with extension to the metadiaphyseal and diaphyseal zones are much less common and can lead to a major decrease in upper limb function and quality of life in older patients [5]. The distal spread of this fracture type the success of conservative treatment with various types of dressings and braces, as well as complicates the use of intramedullary osteosynthesis [6]. The method of choice for the treatment of these types of fractures is locking plate osteosynthesis [7, 8]. Concurrently, the low quality of bone tissue, the risk of reposition loss, the occurrence of varus collapse, and avascular necrosis of the humeral head cause a great number of complications.

We present a rare clinical case of staged surgical treatment of an older female patient with a PH fracture with extension to the diaphyseal zone.

Case report

A 73-year-old patient applied to the European Clinic of Sports Traumatology and Orthopaedics (Mocow) 4 days after the injury resulting from a fall on the left upper limb. An X-ray examination was performed on admission, a multi-fragment fracture of the proximal and middle thirds of the humerus was diagnosed (Fig. 1). Additionally, signs of neuropathy of the left radial nerve and secondary anemia due to blood loss (hemoglobin of 110.0 g/L, erythrocytes of 3.53×10^{12}/L, and hematocrit of 32.10%) were detected.

After patient examenation and preparing for surgical treatment open direct repositioning and plate osteosynthesis were performed through the deltoid-pectoral approach with an additional lateral approach. Surgical treatment was performed in the beach-chair position.

The first step was passing the lag screws through the diaphyseal part of the fracture; however, satisfactory repositioning was not achieved. The lag screws were removed and two cerclage sutures were applied (Fig. 2). Then osteosynthesis was performed with a long PHILOS plate (Synthes) (Fig. 3).

Postoperatively, the patient retained paresis of the radial nerve, and therapy with special neurological therapy was started. Additionally, immobilization in a shoulder brace was performed for 6 weeks, followed by active rehabilitation therapy and staged radiography. Radial nerve paresis resolved 9 months postoperatively with complete radial nerve function restoration.

The control X-rays showed a consolidated fracture of the humeral diaphysis 9 months postoperatively, as well as the development of avascular necrosis of the left humeral head, nonunion, and migration of the greater tubercle into the subacromial space (Fig. 4). The shoulder function was limited, and the pain syndrome up to 5 VAS points persisted during movements, as well as a pronounced limitation of the amplitude of active movements with the abduction of up to 70°, flexion of up to 90°, external rotation of up to 0°, and internal rotation at the L5 level. However, the patient was fully adapted to daily activities.

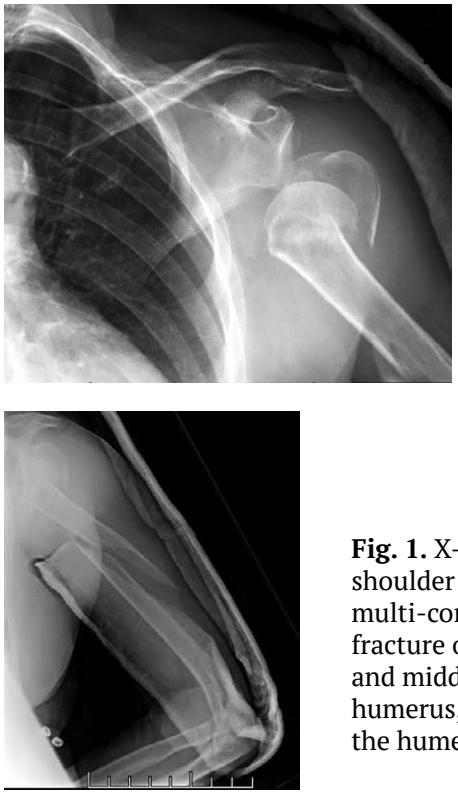

Fig. 1. X-rays of the left shoulder at admission: multi-comminuted fracture of the proximal and middle thirds of the humerus, dislocation of the humeral head

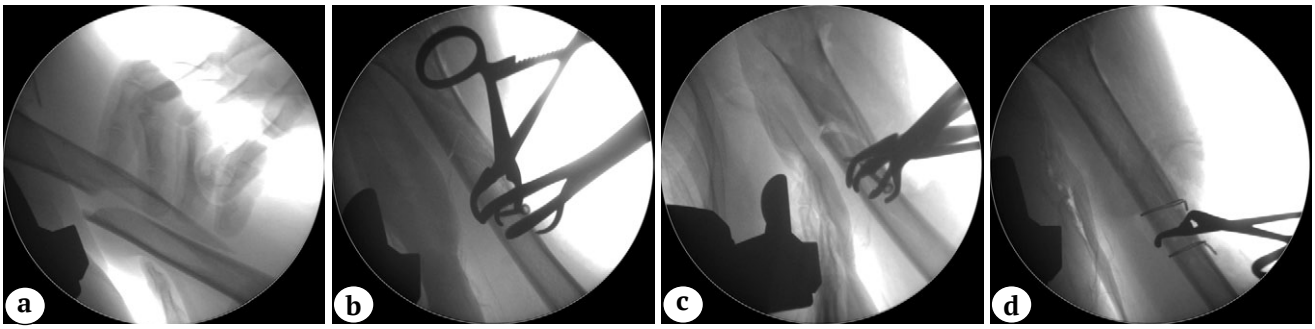

Fig. 2. Intraoperative X-rays:
a — humerus diaphysis fragments displacement; b — reposition of the humerus shaft, lag screws insertion; c — loss of reposition; d — removal of lag screws, cerclages ostheosynthesis

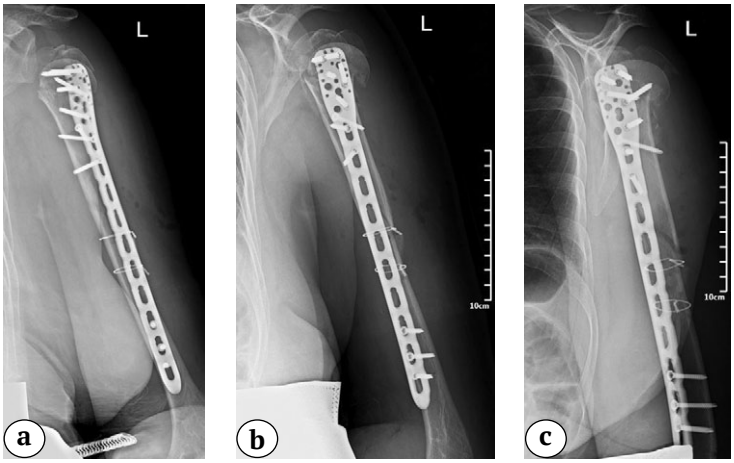

Fig. 3. Postoperative X-ray's after osteosynthesis of the humerus with a PHILOS Long plate and cerclages: a — frontal view; b — lateral view; c — oblique view

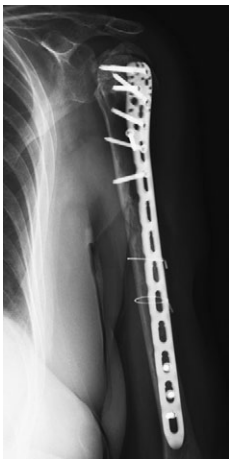

Fig. 4. Shoulder control X-ray after 9 months since surgery: consolidation of the diaphyseal part, nonunion, secondary displacement of the greater tubercle and avascular necrosis of the humeral head

After 20 months, stage 2 of the surgical treatment, including removal of metal fixators and total reverse arthroplasty of the left shoulder, was decided together with the patient due to the persistent pain syndrome. A deltoid-pectoral approach was performed, and the metal fixators were removed. Then, tenotomy of the subscapular muscle tendon and long head biceps tendon was performed, and access to the shoulder joint was provided. The remaining nonviable fragments of the humeral head were removed, cementless metaglene was placed with fixation by three screws, and a 38-mm glenosphere was placed.

A decision was made to install a cemented endoprosthesis stem (size 1, diameter 10) because of the reduced bone quality, thin cortical walls, the risk of low integration, and the risk of endoprosthesis stem instability. The height of the shoulder component was determined by the most intact medial bone edge of the humerus. The 38/+3 cup was installed after fitting. The final radiographs are presented in Figure 5.

The pain syndrome was not registered and the patient was discharged on day 5 after the surgery. Additionally, immobilization in a shoulder brace was performed, and rehabilitation therapy was started.

Subjective assessment of the left shoulder joint function according to the American Shoulder and Elbow Surgeons score (ASES) scale was performed at stage control examinations (Fig. 6).

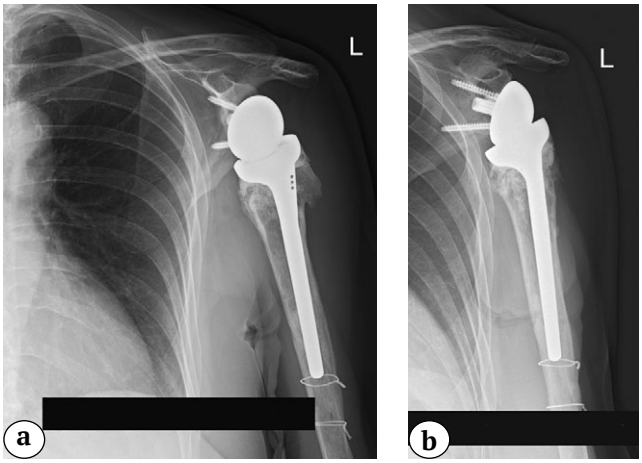

Fig. 5. Shoulder X-rays in the early postoperative period after left shoulder arthroplasty: a — Y-shaped view; b — direct view

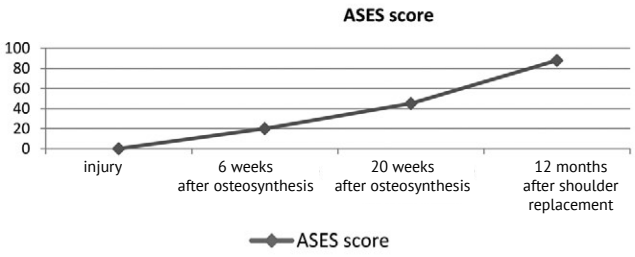

Fig. 6. Dynamics of ASES scores

The patient had no pain syndrome (VAS score of 0), the subjective assessment of the left shoulder function was 90%, and the ASES score was 88 at the final follow-up examination. The patient achieved a complete painless range of motion, while the external rotation deficit persisted, and a lag-sign positive test was noted, when the patient was unable to retain the arm in maximum external rotation.

DISCUSSION

The PH fracture with extension to the diaphysis in geriatric patients is a relatively rare injury and can lead to a sharp decrease in limb function and quality of life. Internal fixation with the long PHILOS plate (Synthes) provides stable fixation due to the anatomical shape of the plate [9].

According to the literature, surgical treatment of PH isolated fractures is associated with a large number of complications (17-32%) [10, 11], among which avascular necrosis of the humeral head is up to 5% [12, 13, 14]. Brunner et al. revealed that geriatric patients have a 2-3 times higher risk of complications compared to young people [10].

The treatment results of patients with PH fractures with extension to the diaphyseal zone vary in the literature. Arumilli et al. revealed that only 2 out of 12 patients with 13 fractures developed postoperative complications (mini-

mal varus collapse in a 73-year-old patient and screw migration in a 53-year-old patient) [6]. James et al. revealed that only 1 of 18 patients had a postoperative complication in the form of transient radial nerve paresis; while no cases of avascular necrosis, nonunion, or delayed union were identified [5]. In our case, aseptic necrosis of the humeral head and nonunion of the humeral tubercles were diagnosed, which may be associated with the fracture severity, the nature of fragment displacements, and the use of open direct reposition.

The nature of complications in our clinical case can be classified as type 1 (aseptic necrosis of the head) and type 4 (nonunion of the humeral tubercles) based on Boileau classification of PH isolated fractures [15]. Schliemann et al. revealed satisfactory results from the total reverse shoulder arthroplasty after osteosynthesis of the PH with the development of aseptic necrosis [16]. Grubhofer et al. revealed satisfactory results in the use of total reverse arthroplasty of the shoulder joint after complications of primary osteosynthesis. Patients with intracapsular fracture complications (types 1 and 2) had a statistically significantly better outcome than patients with extracapsular fracture complications (types 3 and 4) [17]. All studies registered a significant improvement in the values of the orthopedic scales in the postoperative period. Similar results were also obtained in our clinical case (88 points on the ASES scale) at the final follow-up examination.

The use of one-stage total reverse shoulder arthroplasty for PH fracture treatment in older patients provides better clinical results than unipolar arthroplasty or osteosynthesis [18]. A cohort study by E. Sebastia-Forcada et al. compared the results of primary and revision total reverse shoulder arthroplasty. Both groups showed better functional results and fewer complications in the group of primary total reverse shoulder arthroplasty despite a significant improvement in function [19]. Similar results were obtained by Shannon et al. [20].

One of the treatment methods for three- and four-fragment PH fractures is one-stage unipolar arthroplasty. According to some authors, this method effectively reduces the pain level; however, shoulder joint dysfunction often persists due to damage to the rotator cuff of the shoulder joint or nonunion of the humeral tubercles [21, 22]. Thus, Radzhabov et al. described the successful surgical treatment of severe PH fractures using unipolar shoulder arthroplasty [23]. Notably, unipolar arthroplasty in this work was performed in patients without damage to the rotator cuff and signs of omarthrosis. Bonns et al. did not reveal a statistically significant difference in the treatment results of patients over 65 years of age with four-fragment PH fractures using conservative treatment or a unipolar endoprosthesis [24].

A systematic review by Austin et al. revealed significantly superior results using total reverse shoulder arthroplasty (421 patients) than unipolar arthroplasty (492 patients) in terms of postoperative pain syndrome and range of motion levels [25]. Additionally, Gallinet et al. revealed that patients achieved better clinical results and flexion amplitude after reverse shoulder arthroplasty, but patients had a greater amplitude of external and internal rotation after unipolar arthroplasty. Moreover, they established that the incidence of complications and repeated surgeries is higher in patients after total reverse shoulder arthroplasty and the percentage of revisions is higher in patients after unipolar arthroplasty [26].

In our opinion, the use of one-stage unipolar arthroplasty in presented case is inappropriate due to the comminuted nature of the fracture of the humeral tubercles and the proximal metaphysis.

Greiner et al. analyzed 50 cases of shoulder reverse arthroplasty in patients with PH fractures after conservative treatment, osteosynthesis, or unipolar arthroplasty and revealed that the metaphyseal bone defect of >3 cm and atrophy or avulsion of the teres minor muscle are statistically significant negative prognostic factors that affect the clinical treatment results. The authors noted that the fixation of the endoprosthesis humerus component depends on the diaphyseal fixation in case of metaphyseal defects of the humerus, which can often be inconsistent. Insufficiency of tension in the musculus deltoideus is often noted in combination with difficulties in reconstructing the anterior and posterior parts of the rotator cuff [27].

A defect in the metaphyseal zone leads to rotational and axial instability, difficulties in installation due to the lack of bone markers, and an increased risk of instability of the shoulder component of the endoprosthesis, dislocations, weakness of the upper limb, and functional impairment in PH fractures.

Our clinical case revealed no formed metaphyseal defect at the time of the primary surgery; however, the intermediate fragment was significantly larger than 3 cm and extended to the middle third of the humeral diaphysis, which could adversely affect the stability of fixation of the shoulder component of the endoprosthesis during a one-stage surgery and the deltoid muscle function (tension). However, in our opinion, the use of shoulder reverse arthroplasty in combination with diaphysis cerclage osteosynthesisis possible in this case but is associated with certain risks.

CONCLUSION

The presented clinical case shows that the use of sequential osteosynthesis and total shoulder reverse arthroplasty achieves satisfactory results with injured limb function restoration and pain elimination. Damage to the rotator cuff or tubercles of the humerus, the degree of metaphyseal defect of the humerus, age, and comorbidities are important factors to consider during surgical treatment planning.

DISCLAIMERS

Author contribution

All authors made equal contributions to the study and the publication.

All authors have read and approved the final version of the manuscript of the article. All authors agree to bear responsibility for all aspects of the study to ensure proper consideration and resolution of all possible issues related to the correctness and reliability of any part of the work.

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Ethics approval. Not applicable.

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