

EPIDEMIOLOGY AND FORENSIC IMPLICATIONS OF COMPLEX PROXIMAL HUMERAL FRACTURES

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Abstract: Fractures of the proximal humerus account for 7% of all fractures and 80% of humerus fractures, with a higher incidence in women. Among patients aged 65 years and older, proximal humeral fractures are the second most frequent upper extremity fractures and the third most frequent osteoporotic fractures, after proximal femur and distal radius fractures. Studies show that the incidence of proximal humeral fractures increases by approximately 40% every five years. In the United States, an estimated 275,000 patients will present to the emergency department with his proximal humeral level fracture by 2030. Fractures of the proximal humerus increase the risk of subsequent fractures of the proximal femur and distal forearm. The risk of fracture at the proximal femoral level following a fracture of the proximal humerus was 16%, the same as that following a fracture of the distal radius.

The forensic implications are important in evaluating the number of days of medical care especially in malpraxis cases. Incorrect treatment of the humeral fractures may lead to an important increase of the time of recovery and as a consequence complex medico-legal implications.

Keywords: fracture, humerus, recovery.

INTRODUCTION

Proximal humeral fractures, defined as fractures located at the level of the neck and/or head of the humerus, are the most common fractures affecting the shoulder girdle in adults, with a steadily increasing incidence. Fractures of the proximal humerus often present a treatment dilemma, and understanding the characteristics of each fracture type can range from simple to complex processes [1-4].

A minimal, nonsurgical approach is attractive for the management of proximal humeral fractures in the elderly. This is given the general association with osteoporosis, which complicates surgical management.

The most common surgical treatment for proximal humeral fractures is plate and screw internal fixation. Direct visualization of intraoperative fracture lesions allows manipulation and fragment reduction with correct implant placement [5].

Although the majority of proximal humeral fractures are non-displaced or minimally displaced

and may benefit from orthopedic management, European studies show a growing trend toward surgical management have been shown to be effective, but no consensus has been reached on the optimal surgical technique [5-7]. With so many treatment options, each with its own strengths and weaknesses, it is difficult to assess the risk of complications and desired benefits.

The numerous local complications and sequelae resulting from proximal humerus fractures require a thorough evaluation of the patient in order to develop and apply an appropriate treatment plan.

MATERIALS AND METHODS

After obtaining the approval for data extraction and processing from the Klinikum Aschaffenburg-Alzenau in Germany and after obtaining the ethics approval from the Ethics Commission of the “Grigore T. Popa” University of Medicine and Pharmacy in Iasi, we retrospectively analyzed a batch of 128 of patients admitted and treated in Klinikum Aschaffenburg-

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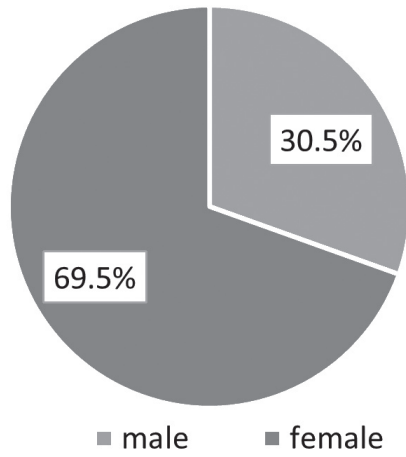


Figure 1. Distribution by gender.

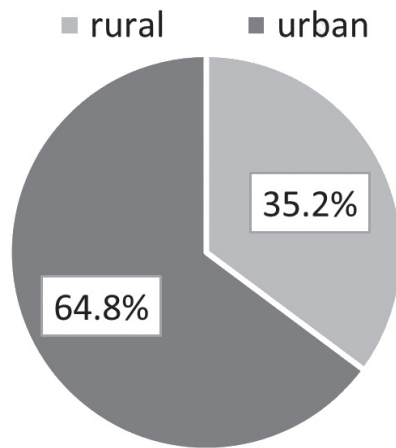


Figure 2. Lot distribution by medium of origin.

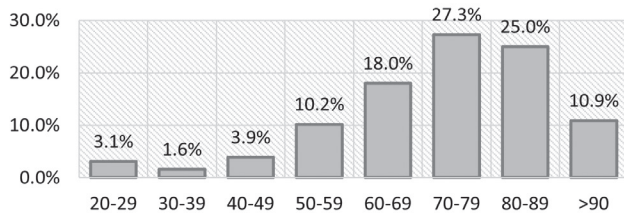


Figure 3. Distribution by age groups.

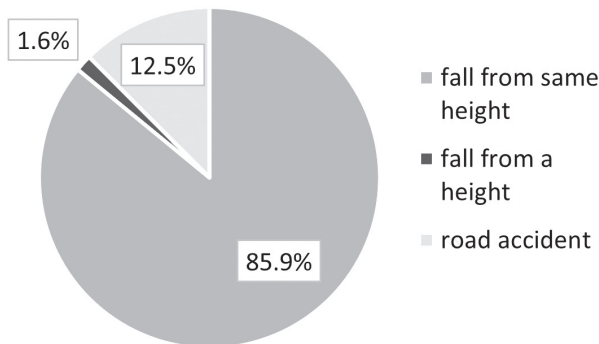


Figure 4. Distribution of proximal humerus fractures according to the fracture mechanism.

Alzenau in Germany between 01.01.2016 and 31.12.2016.

Data used in the study were obtained from the Single Integrated Informatics System (SIUI) and general clinical observation sheets, and were analyzed using IBM SPSS Version 18 software (SPSS Inc, Chicago, IL, USA). The analytical study was conducted by applying statistical hypothesis testing tests, with the standard significance threshold of $p < 0.05$.

RESULTS

The distribution of cases by gender revealed a higher incidence of proximal humerus fractures in female patients (69.5% of cases), with a female:male sex ratio of 2.27:1 (Fig. 1).

Depending on the area of origin, we noted a higher incidence of patients from the urban environment (64.8% of cases), the urban:rural quota ratio being 1.84:1 (Fig. 2).

Regarding the correlation between the area of origin and the age groups, we noticed that there were statistically significantly more patients from the urban area, with an average age of 67.33 ± 16.19 years, with values between 25 and 95 years, compared to the rural environment for which the average value was 80.89 ± 9.68 years, with variations between 56 and 97 years ($p=0.000$).

The incidence of proximal humerus fractures by age group was maximum in the age group 70-79 years (27.3%), followed by the age group 80-89 years (25%), while the minimum incidence was in the 30-39 age group (1.6%) (Fig. 3).

The average value of the patients' age was significantly lower in male patients, with a value of 63.72 ± 19.42 years and variations between 25 and 93 years. For the female sex, the average value was 75.76 ± 12.09 years, with variations between 42 and 97 years ($p=0.001$).

In the study group, among the mechanisms of proximal humerus fractures, the most common was falling from the same level (110 cases), followed by road accidents (16 cases) and falling from a height (2 cases) (Fig. 4).

From the personal pathological antecedents of the patients in the study group, we found an increased incidence of hypertension, followed by the frequency of osteoporosis, diabetes, chronic venous insufficiency of the lower limbs, other previous fractures, cardiovascular diseases and psychiatric diseases. Other conditions presented by the patients included in the study group,

but with a low, sporadic incidence, were renal failure in 4 cases, respiratory conditions such as bronchial asthma, chronic respiratory failure and chronic bronchitis in 4 cases, presbycusis in 2 cases and one each case with right shoulder hemiarthroplasty (operated in 2014), gout, left hemiparesis, hypothyroidism, etc.

The comparative analysis by sex showed that the distribution of secondary diagnoses was relatively

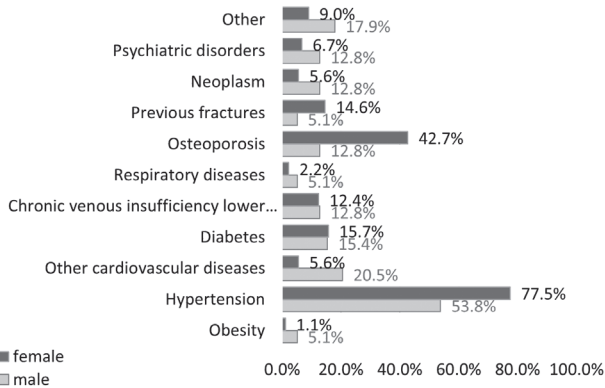


Figure 5. Identified secondary diagnoses – comparative study by gender.

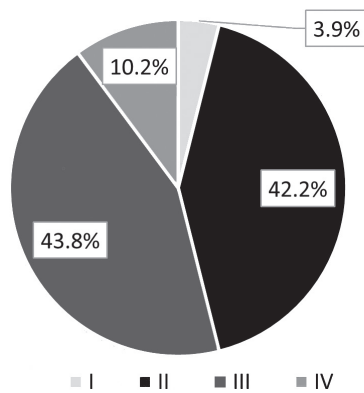


Figure 6. The structure of the analyzed batch according to the NEER classification.

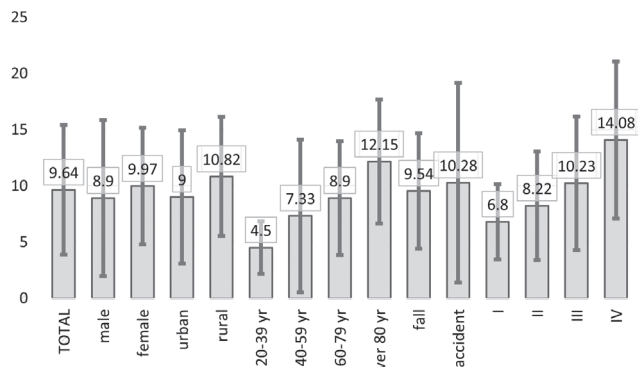


Figure 7. The number of days of hospitalization – average values compared by sex, averages of origin, distribution by age groups, mechanism of fracture production, NEER classification and AO classification.

similar in both sexes, with some statistically significant differences in patients with osteoporosis (87.2% in males and 57.3% in females, $p=0.001$), with essential arterial hypertension (46.2% in males, respectively 22.5% in females, $p=0.007$) and patients who presented other cardiovascular diseases (79.5% in males and 94.4% in females female, $p=0.022$) (Fig. 5).

According to the NEER classification according to the number of fractured fragments and fracture displacement, type III proximal humerus fractures predominated with 56 cases (43.8%), followed by type II fractures with 54 cases (42.2%) and type IV with 13 cases (10.2%). Type I fractures had the lowest incidence, with only 5 cases (3.9%) (Fig. 6).

We found statistically significant differences regarding the correlation of the number of days of hospitalization with the sex of the patient ($p=0.250$), the environment of origin ($p=0.004$), the distribution by age groups ($p=0.000$), the NEER classification ($p=0.001$) and AO classification ($p=0.000$) (Fig. 7); thus, the average number of days of hospitalization was significantly higher in women, in rural patients, in the age group over 80 years, in type IV fractures according to the NEER classification and class C according to the AO classification; moreover, the number of days of hospitalization increased progressively with the age of the patients and the placement of the fracture in a higher category.

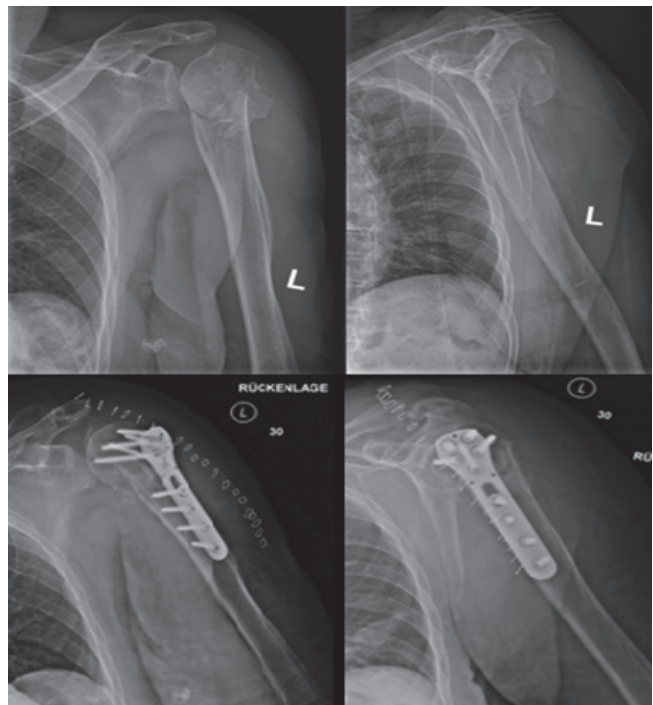


Figure 8. Complex fracture left proximal humerus. Locked plate osteosynthesis with monoaxial angular stability (Image from the archive of Klinikum Aschaffenburg - Alzenau, Germany).

In the analyzed group, the types of surgical treatment were osteosynthesis with angular stability plate (Fig. 8) in 102 cases, shoulder arthroplasty in 14 cases, osteosynthesis with centromedullary nail in 11 cases and in 6 cases osteosynthesis with screws or brooches was practiced.

The patients benefited from one or more types of interventions depending on their evolution, for this reason the number of interventions was higher than the number of patients.

The analysis of the complications after the surgical intervention showed that in 5 cases there was damage to the osteosynthesis material with the secondary displacement of the fracture, in one case the patients developed necrosis of the humeral head with the penetration of the screws, pseudarthrosis of the proximal humerus and peri-implant fracture, and in 2 cases patients reported significant pain accompanied by marked limitation of right shoulder mobility.

DISCUSSION

The management of proximal humerus fractures and the selection of optimal therapy remains challenging. The choice of implant must be based on well-defined indications and contraindications based on the individual characteristics of the patient and the nature of the fracture [8-10].

The randomized trial by Olerud *et al.* [11] on a group of elderly patients with three-part proximal humerus fracture according to the Neer classification, aged between 56 and 92 years (mean age 73 years), of which 81% were female, show that osteosynthesis with blocked plate (30 cases) had better functional results at 2 years compared to non-operative treatment (30 cases), regarding regaining mobility and functionality. In the group treated non-surgically, Olerud *et al.* [11] found that in 86% of cases healing occurred in various defective positions, in one case non-consolidation was reported, while only 14% of patients showed healing in a satisfactory position according to with the criteria for a good discount. Complications were impingement (3% of cases), post-traumatic osteoarthritis (3% of cases), and minor avascular necrosis (7% of cases). Although the incidence of complications and surgical reinterventions, implicitly also the costs, is higher in patients with operative treatment, Olerud *et al.* concluded that elderly patients with three-part complex fractures had better outcomes in the group treated surgically with locked plate osteosynthesis than in the group receiving functional treatment.

In displaced proximal humerus fractures, nonsurgical treatment has not shown consistently satisfactory results, while locked-plate reconstructive surgery has had good results in younger patients, but in the elderly has resulted in a relatively increased frequency of complications. And hemiarthroplasty, long considered the treatment of choice, frequently led to unsatisfactory functional results due to vicious consolidation of the tubercles. So the functional results after surgical reconstruction are better than after hemiarthroplasty [12,13].

The use of locked plate or centromedullary nail osteosynthesis was associated with a high rate of complications, which in 30% of cases required reoperation or removal of the implant. The most common complications were due to screw migration, usually intra-articular penetration, and related subacromial impingement. Serious complications, such as varus deformity, displacement of the trochiter, collapse of the humeral head by more than 20% (37% of cases treated with centromedullary nail and 4.6% for blocked plate), aseptic vascular necrosis were much less common (rate varying between 3.7% and 11.8% for the centromedullary nail) and vicious consolidation. An iatrogenic complication was the production of an additional fracture through the rod entry point (up to 17.9% of cases). The overall rate of postfixation displacement and aseptic vascular necrosis appears to have decreased significantly following replacement of traditional plates with specially designed locking plates [9, 14, 15].

In conclusion, choosing the optimal treatment for complex fractures of the proximal humerus remains difficult. The complexity of the fracture, the patient's age, the pathological antecedents, the quality of the bone material are the most important factors, but also the activity he carries out, the risks he is exposed to and, last but not least, the benefit of the method are factors that determine the adoption of a certain therapeutic methods. A thorough evaluation of the patient can lead to the correct choice of the type of treatment, thus avoiding medico-legal implications.

Conflict of interest

The authors declare that they have no conflict of interest.

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