Place of surgery in the treatment of complex fractures of the upper extremity of the humerus

ABSTRACT

It is a retrospective study of 18 cases of complex fractures of the upper extremity of the humerus, collected in the Department of Traumatology-Orthopedics I of the Military Hospital of Rabat, over a period extending from January 2013 to October 2016. The average age of our patients was 65 years with a female predominance (F/H=1.6). Patients were all traumatized in the upper limb, the diagnosis was moderately imaging, i.e., a frontal X-ray, and a CT scan of the traumatized shoulder, which revealed according to the classification of Neer and Duparc, fractures with 4 fragments in 10 cases and fractures with three fragments in 8 cases. Treatment consisted of surgery by osteosynthesis or prosthetic replacement. Immobilization was indicated only for patients treated with osteosynthesis. The mean follow-up was 12 months. Functional results were average in 9 cases, and excellent in 8 cases, with an average score of 58.6 points. The stiffness of the shoulder was the main complication found in our series (7 patients). There was no significant difference in the functional results, between the orthopedic treatment reported in the literature and the surgical treatment performed in our series. Moreover, the results after the osteosynthesis are much better compared to the prosthetic replacement. As a result, complex fractures of the proximal humerus are fractures that are difficult to manage and there is no well-coded management consensus for these fractures.

Keywords: complex fractures, upper extremity, humerus

RESUME:

Il s'agit d'une étude rétrospective de 18 cas de fractures complexes de l'extrémité supérieure de l'humérus, pris en charge au Département de Traumatologie-Orthopédie I de l'Hôpital Militaire de Rabat, sur une période allant de janvier 2013 à octobre 2016. L'âge moyen de nos patients était de 65 ans avec une prédominance féminine (F / H = 1,6). Les patients étaient tous des traumatisés des membres supérieurs, le diagnostic était basé sur les données de l'imagerie.
l’imagerie, avec une radiographie frontale, et un scanner de l’épaule traumatisée, qui ont révélé selon la classification de Neer et Duparc, des fractures avec 4 fragments dans 10 cas et des fractures à trois fragments dans 8 cas. Le traitement consistait en une chirurgie par ostéosynthèse ou remplacement prothétique. L’immobilisation n’était indiquée que chez les patients traités par ostéosynthèse. Le suivi moyen était de 12 mois. Les résultats fonctionnels étaient moyens dans 9 cas et excellents dans 8 cas, avec un score moyen de 58,6 points.

La raideur de l’épaule était la principale complication retrouvée dans notre série (7 patients). Dans notre série, il n’y avait pas de différence significative dans les résultats fonctionnels entre les traitements orthopédique et le chirurgical effectué, par contre les résultats après ostéosynthèse ont été bien meilleurs au remplacement prothétique.

En conséquence, les fractures complexes de l’humérus proximal sont des fractures difficiles à gérer et il n’en existe pas de consensus de gestion bien codé.

Mots-clés: fractures complexes, membre supérieur, humérus

INTRODUCTION

The complex fractures of the upper extremity of the humerus are defined by a solution of continuity of the metaphysis and the epiphysis of the proximal extremity; Which sits above the lower edge of the pectoralis major. Complex fractures are essentially represented by three- and four-fracture fragments, according to Neer [1]. They reach 13-15% [2,3] of all fractures of the proximal humerus. Their incidence is constantly increasing due to the aging of the population and osteoporosis. Many complications are associated with it. The therapeutic management of these complex fractures has been and remains controversial. Our work on the place of surgery in the treatment of complex fractures of the upper extremity of the humerus makes it possible to evaluate the results of different methods of surgical treatment and to compare them with the results of orthopedic treatment reported in the literature.

MATERIALS – METHODS

Eighteen patients were operated on for complex fractures of the proximal end of the humerus between 2013 and 2016 (Figure1) and were reviewed with an average follow-up of 12 months. The majority of our patients were women (11 cases), a sex ratio of 1.6, with an average age of 65 years (40 to 85 years). The circumstances of the trauma were dominated by falls in height (8 patients) and road accidents (7 patients). The right side was the most affected side found in 12 patients. All our patients presented with an upper limb trauma, a simple bruising or Hennequin, edema and deformation were inconstant clinical signs, and no skin opening was observed.

All our patients received a preoperative radiological assessment with a traumatic limb face incidence. As well as a computed tomography scan with 3D reconstruction of the traumatized shoulder.

We classified our fractures according to the Neer classification with: 8 fractures with 3 fragments, 10 fractures with 4 fragments. A classification was added, that of Duparc, which classified the fractures: 8 sub-tuberosous fractures, 7 isolated cephalo-tuberosal fractures, and 3 cephalo-tuberosal fractures
associated with luxation (Table 1 and 2).

In our series, a delto-pectoral approach was performed on 7 shoulders, 3 of which were treated by screwed plate (Figure 2) and 4 patients were treated with hemiarthroplasty (Figure 3). The remaining 11 patients were treated by racking (Figure 4), according to different techniques, including 6 patients treated by Hacketal implantation, combined with direct insertion, and 4 patients were treated with Kapandji percutaneous insertion and only one patient who was treated by direct plug-in alone. With an average surgical delay of 4 days.

Postoperative radiological findings were based on the Cuny Criteria [4] for analyzing the mean angle of inclination of the alpha F humeral head measured on a frontal incidence and the mean height difference between the top of the tuber Major and the outer edge of the humeral head αH, considering the normality of angle αF: which is 45 °, calculating the difference between αF measured and theoretical αF: ΔαF and measuring αH.

While the functional results were evaluated according to the Constant score [5], this score includes 11 items grouped into 4 axes: pain, daily activities, mobility and muscle strength. The score is scored on 100 points, with 35 points as subjective data and 65 points as objective data. A score of 100/100 is considered the best score.

This evaluation is based on the differential between the Constant index (IC) on the treated side and the healthy side.

RESULTS:

Radiological findings:

According to the criteria of Cuny, 4 groups of reduction were individualized: anatomical, sub-anatomical, intermediate and bad. Fracture reduction was in most cases sub-anatomical (55.56%), the reduction
was anatomical in 22.22%, and not anatomical in 22.22%.

### Table 1: Different types of fractures in our series according to the Neer classification.

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture with 3 fragments</td>
<td>8</td>
<td>44.40%</td>
</tr>
<tr>
<td>Fracture with 4 fragments</td>
<td>10</td>
<td>55.60%</td>
</tr>
</tbody>
</table>

Functional results
With an average of 12 months, the average Constant score was 58.6 points.

### Table 2: Different types of fractures in our series according to the Duparc classification

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-tuberous fracture + major tuber</td>
<td>8</td>
<td>44,40%</td>
</tr>
<tr>
<td>Isolated cerebrospinal fracture</td>
<td>7</td>
<td>38,90%</td>
</tr>
<tr>
<td>Cerebrospinal fracture + dislocation</td>
<td>3</td>
<td>16,70%</td>
</tr>
</tbody>
</table>

45% of patients had good, very good and excellent results, 50% had average results and only 5% had poor results. *(Table 3)*. Taking age into account, this score was good in the 40-60 age group. Less good in subjects between 60 and 80 years, and bad in the oldest, 80 years and older.

The therapeutic efficacy depends on the type of treatment undertaken *(Table 4)*. Patients treated by racking in all techniques combined had an average Constant score of 67.3 points. After screwed plate, the average score was 63 points, and after hemiarthroplasty, this score was 49.3 points.
Complications

Seven patients had a delayed stiffness of the shoulder, three patients were complicated with a vicious callus, and only one case of pseudarthrosis was reported. No other complications were found.

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Constant Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Racking</td>
<td>66.3 pts</td>
</tr>
<tr>
<td>Screw plate</td>
<td>63 pts</td>
</tr>
<tr>
<td>hemiarthroplasty</td>
<td>49.3 pts</td>
</tr>
</tbody>
</table>

Table 3: Distribution of Constant Score according to the type of treatment undertaken.

<table>
<thead>
<tr>
<th>Treatment undertaken</th>
<th>Excellent and good results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hackelal Plug</td>
<td>83.3%</td>
</tr>
<tr>
<td>Connection according to Kapandji</td>
<td>50%</td>
</tr>
<tr>
<td>Direct plugging</td>
<td>0%</td>
</tr>
<tr>
<td>Screw plate</td>
<td>33.3%</td>
</tr>
<tr>
<td>hemiarthroplasty</td>
<td>25%</td>
</tr>
</tbody>
</table>

Table 4: Percentage of excellent and good results found with the different types of treatment undertaken.

DISCUSSION

Comparing our findings with those reported in the literature, we found the following:

In our series, the average age of our patients was close to 65 years, with female predominance with sex ratio of 1.6, and often following a fall of their height, interesting the right side predominates, which is consistent with the data of the literature [6-8]. All our patients were presented with a traumatized attitude of the upper limb.

The standard X-ray images consist, usually in a double-sided facial image and a trans-thoracic profile. This makes it possible to make the diagnosis, to classify the fracture and to appreciate the quality of the bone.

Computed tomography (CT) with 3D reconstruction (Figure 5) allows better analysis of fracture and displacement, provides more detail on bone quality, increases measurement accuracy of tilt angles, and provides a sketch of prognosis.

All our patients had a standard face x-ray and CT with 3D reconstruction of the traumatized shoulder.

In order to identify these fractures, several classifications have been proposed, initially, of the so-called descriptive classifications, namely the classification of Neer, AO / ASIF, Duparc, AST, or more recently Hertel And Edelson. These classifications were primarily concerned with the assessment of the risk of cephalic...
necrosis. Other so-called mechanistic classifications have emerged. They are mainly based on the displacement of "parts", the latter having an impact on the management of the fracture, on the therapeutic strategy and on the prognosis. Several series of the literature [9] show the predominance of 4-fracture fractures compared to fragments with 3 fragments. This was consistent with the data found in our series.

The treatment of complex fractures has been and remains controversial. There are many treatment options available, including orthopedic treatment, various osteosynthesis techniques and prosthetic replacement.

The use of orthopedic treatment in complex fractures of the proximal humer has shown average functional results reported by several series of the literature [10].

The various types of osteosynthesis are divided into sockets, osteo-sutures. Plates, centromedullary nodules, and Bilboquet implant.

For prosthetic replacement, two types of prosthesis can be used: the cephalic prosthesis or the hemiarthroplasty, and the total inverted shoulder prosthesis.

By comparing our functional results after surgical treatment and the results reported in the literature [10] after orthopedic treatment, we found that there was no great difference between the two types of treatment.

Our functional results evaluated according to the Constant score (45% good and excellent results), this percentage was different according to the type of osteosynthesis used, it is 83.3% for patients operated by plugging according to Hacketal, 50% for patients operated on by Kapandji, 33.3% of good and excellent results for patients operated by screwed plate, and only 25% of patients who underwent Hemiarthroplasty performed well; And for the patient who was operated by direct racking the result was not good. These results can be superimposed on the series of the literature: 76% good to excellent results for the series of carbon et al [11] for the plugging treatment, and 80% for the series of kim et al. And 50% of good results in patients operated with hemiarthroplasty [13], the results of prosthetic surgery were better with the total reversed prosthesis.

There is agreement in the literature that fragments with three fragments according to Neer gave better results than fractures with four fragments. Our results were comparable to those found in the literature, 75% were good results in the treatment of complex fractures of the proximal end of the humerus with three fragments, they perfectly agree with the results of Zhang et al. [12] Who found 80% of the good results. And it was concluded that only 30% of good results in our series concerning the treatment of fractures with four fragments fit perfectly with the results found in the Lanting series (34.5%).

Anatomical reductions were observed in 22.22% of cases, while the reduction was non-anatomical in 22.2% of cases,
and 56.6% of cases were as sub-anatomic reduction. The pathways and their indications according to the anatomo-clinical type of the fracture and according to the quality of bone [16] were well described by Neer [17]. In our series, we used direct percutaneous embedding when fracture with 3 or 4 fragments without significant comminution and with good bone quality [18]. Retrograde embedding, according to Kapandji or according to Hacketal, is indicated in fractures To 3 fragments where there is no displacement of the major tubercle, whereas for the comminutive fractures, the delto-pectoral pathway [19] is necessary in order to obtain a better endo-articular control of the latter. In our series we used the delto-pectoral route in 7 patients, 4 of whom were treated with hemiarthroplasty, and three patients were treated with a screw plate, which was indicated in the case of a non-reconstructible fracture of 4 fragments, and In case of fracture with 3 fragments.

Rehabilitation is an essential and essential step in the therapeutic management of any fracture. This firstly passive and then active rehabilitation. Vascular lesions are frequent complications of surgery for complex fractures of the humerus, and their incidence varies from 5 to 30% depending on the series [20]. In our study, no vascular lesions were observed.

In the literature, the incidence of nerve lesions in the series of Gupta et al [21] was 8.4%, in our series no nerve lesions were revealed. Orelud [22] reported in his series 16% of secondary displacement which had no correlation with the type of treatment used. In our series no cases of secondary displacement were observed. The postoperative shoulder stiffness is by far the most frequent complication, with an incidence varying between 5.3% and 11.2%. Rapetto et al [23] reported 8.3% stiffness of the shoulder. The incidence in the Bonnevialle et al. [24] series was 11.2%. In our series the stiffness of the shoulder was present in seven of our patients (38.9%). There is a consensus that the best prevention against the occurrence of stiffness is the achievement of the most anatomical reduction possible. In our series, seven cases of posttraumatic stiffness were reported at 3 months postoperatively following the complexity of the initial fracture, the choice of treatment undertaken and the effectiveness of the rehabilitation. The vicious callus was observed in three patients, reaching 18.20% of cases according to Doursounian [8].

**CONCLUSION**

Complex fractures represent a non-negligible entity among fractures of the proximal humerus. Their incidence is increasing due to the aging of the population. Indeed the occurrence is more frequent in the elderly, osteoporotic and often multi-tared, making the treatment difficult to
manage these fractures. The numerous therapeutic options that exist give varying results, and as a result, no decisional consensus for care has been clearly established to date. Orthopedic treatment would have a fairly satisfactory function and could thus be achieved in subjects unable to tolerate any surgical procedure. Surgical treatment with osteosynthesis provides satisfactory and early functional results. Prosthetic replacement remains an option that has yielded average results, still allowing a certain autonomy for the elderly. Functional results are influenced by several factors, such as the type of fracture, which are better in less complex fractures. The stiffness of the shoulder was the most frequent complication that can be prevented by early rehabilitation.

REFERENCES

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