

RETROSPECTIVE FUNCTIONAL ASSESSMENT OF PATIENTS WITH HUMERUS PROXIMAL FRACTURES INTERNALLY FIXED WITH A FIXED-ANGLE PLATE FOR PROXIMAL HUMERUS AREA

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SUMMARY

Proximal humeral fractures are common injuries leading to severe functional restrictions and complications for patients. Today, there are several surgical alternatives aimed at achieving better injury stabilization by means of osteosynthesis techniques, depending on injury severity. One of these is the fixed-angle plate fixation of the proximal humerus. This bone fixation system is intended to preserve the biologic integrity of the humeral head associated with a safe anatomical reduction, employing several fixating screws with angle stability, thereby allowing an early mobilization of the fractured limb. Eleven pa-

tients with proximal humeral fractures treated with the method of fixed-angle plate fixation of the proximal humerus in the period of 2004 to 2005 were retrospectively studied. The patients were subjected to the Constant questionnaire and the DASH index for functional assessment. The results showed some residual dysfunction at the upper end after this type of trauma, even using a fixed-angle plate fixation of the proximal humerus, which notably provides a safe fixation, associated to physical therapy.

Keywords: *Shoulder Fractures; Fracture Fixation, Internal; Upper Extremity*

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INTRODUCTION

Proximal fractures of the humerus are common injuries, accounting for approximately 10%⁽¹⁾ of all fractures and for 70% of humeral fractures^(2,3). They comprise three structures: the humeral head, the anatomical neck and the surgical neck. Neer classified the occurrence of this kind of fractures based on the position of the four potential fracture fragments involved (humeral head, shaft, major tuberosity and minor tuberosity), with fractures ranging from one to four parts. What Neer names as part of the fracture is when a displacement superior to 1 cm or an angle above 45° exists⁽⁴⁾. There are four kinds of two-part fractures: anatomical neck, surgical neck, major tuberosity, and minor tuberosity. Three-part fractures involve the great tuberosity or the minor tuberosity together with the surgical neck fracture. The four-part fracture is characterized by the displacement of all four segments^(3,5) (Figure 1). The key mechanisms of injury for this kind of fracture are based in simple falls, when

the patient supports his/her own body weight with the hand or elbow (external rotation associated to abduction), or by direct trauma on lateral shoulder surface, especially in women (ratio women/men 2:1)⁽⁶⁾.

In proximal humerus fractures some early complications may be found. The proximity of the brachial plexus to glenohumeral joint increases the risks of associated nervous injuries in 6.2% of the cases. The axillary nerve is most commonly involved due to its position, traveling inferiorly to the sub scapular muscle and around humeral surgical neck⁽³⁾. Today, some surgical treatment alternatives are available intending to provide better injury stabilization by means of osteosynthesis techniques depending on the severity of the injury. Among these, the plate with fixed-angle screws has been used in the proximal region of the humerus. This bone fixation is intended to preserve the biological integrity of the humeral head associated to a safe anatomical reduction by using multiple fixation screws with

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Source: HCFMRP-USP files.

Figure 1 – Proximal fracture of the humerus (Neer 2-part).

angle stability, thus allowing for an early mobilization of the fractured limb⁽⁷⁾ (Figure 2).

The modality of bone union using plates is based on the principle of compression plates fixation⁽⁶⁾, with the direct cortical contact associated to an intact intramedullary vascularization, enabling primary bone union basically depending of the bone's osteoclastic resorption, followed by osteoblastic formation. This process occurs with no bone callus formation, which is typical in secondary union⁽⁶⁾. The use of plates with fixed-angle screws is indicated in cases of two-, three- and four-part fractures involving osteopenic bone, as well as in cases of pseudoarthrosis and osteotomy of the proximal humerus, thus being contraindicated in children in growing



Source: HCFMRP-USP files.

Figure 2 – ORIF with PHILOS® plate.

phases, as well as in cases of acute infection⁽⁷⁾, with the most common surgical approach being the deltoid-pectoralis incision (Figure 3).



Source: Authors' data

Figure 3 – Access to surgical site enabled by a deltoid-pectoralis incision.

A long-lasting immobilization of the fractured member, particularly at the shoulder joint complex, after reduction and stabilization, may lead to late complications such as joint stiffness, adhesive capsulitis, as well as lost muscular strength⁽²⁾. Currently, the application of questionnaires and indexes to functionally assess body segments is being used. Among those, the Constant's questionnaire⁽⁹⁾, specifically designed for shoulder conditions, and the DASH (*Disabilities of the Arm, Shoulder and Hand*) index⁽¹⁰⁾ have been applied to quantify upper limbs function. The purpose of this study was to assess upper limb's function using the Constant's questionnaire and the DASH index in patients diagnosed with proximal humerus fractures fixed by plates with fixed-angle screws at the proximal region of the humerus who were submitted to postoperative rehabilitation program in our service between 2004 and 2005.

METHODS

This study was developed at the Physical Therapy Department of Hospital das Clínicas - University of São Paulo's Medical School, Ribeirão Preto campus (HCFMRP – USP) and approved by the Committee of Ethics of that Hospital. Eleven individuals were selected (3 males and 8 females) with mean age of 52.6 ± 17.8 years. According to the classification by Neer⁽⁴⁾, 3 patients showed proximal humerus fractures in two parts, 4 patients presented with three-part fractures, and 4 patients with four-part fractures. These individuals were submitted to open reduction with internal fixation (ORIF) with a plate with fixed-angle screws for the proximal region of the humerus and to postoperative physical therapy between 2004 and 2005, being regarded as rehabilitated at the moment this study was conducted.

Patients of both sexes were assessed, being referred from the Orthopaedic service at the same hospital with diagnosed proximal humerus fractures based on Neer's classification (two, three or four parts), and treated with plate with fixed-angle screws for the proximal region of the humerus. Initially, a physi-

cal evaluation was conducted including diagnosis, anamnesis, manual qualitative test of muscular strength and goniometry of the injured upper limb. At the functional assessment, the Constant's questionnaire⁽¹⁰⁾ was applied, which is a method based on a maximum score of 100. It assesses four individual parameters, namely: pain (15 points), daily life activities (20 points), range of motion (40 points), and strength (25 points). The higher the score, the more satisfactory the shoulder function. The subjective assessment of pain is performed by means of the pain analogical scale and also by measuring daily life activities in a specific given movement. Objectively, the range of motion is measured by goniometry, and muscular strength by progressive weight lifting. Thus, the items of the questionnaire correspond to a particular function related to daily life activities, with pain and quality of movements implying on the overall score. Regarding the DASH functional disability index⁽¹¹⁾, this is composed by a set of questions related to upper limbs' functions, in addition to symptoms (pain, tingling, weakness). The answers have a spectrum of possibilities with scores ranging from one to five, in a total of 30 questions, with the minimum score corresponding to a more satisfactory function. The lower the final score, which can range from 0 to 100, the milder the dysfunction.

RESULTS

For the physical-functional evaluation, the individuals were divided into groups according to Neer's classification⁽⁴⁾, with averages being calculated for each group. Regarding the mechanism of trauma, we found that the highest incidence was simple falls (eight patients), and three other patients were assigned to the traffic accidents group. At physical evaluation, we noticed that the majority of the patients reported pain at bone palpation at humeral head region, at the long tendon of the biceps muscle, and on deltoid muscle on the affected limb. Some presented with antalgic stance. But, most evidently, a reduced muscular strength and range of motion (ROM) were seen. The manual qualitative test of muscular function graded from 0 to 5⁽¹¹⁾ indicated that the patients presenting more severe proximal humerus fractures (four parts) had, in average, a further reduced muscular strength, particularly upon flexion, abduction and external rotation movements of the shoulder (Table 1).

	Neer's 2 parts	Neer's 3 parts	Neer's 4 parts
Flexion	4	4	3
Extension	5	4	4
Abduction	4	4	3
Adduction	5	5	5
Internal rotation	5	5	4
External rotation	4	4	3

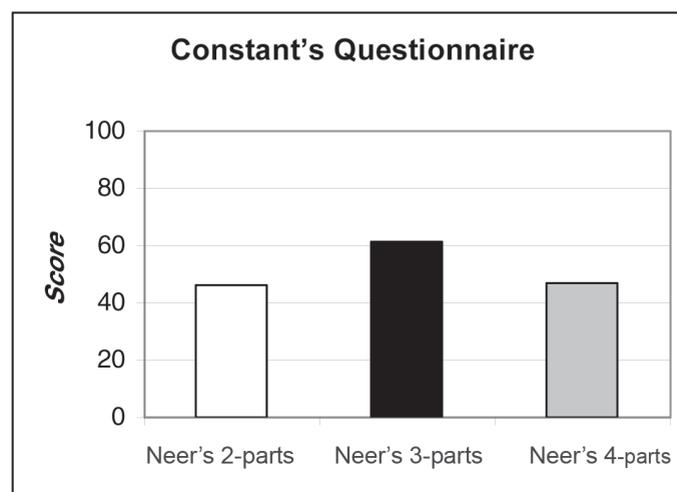
Table 1 – Averages of the results obtained from measurements of muscular strength degree for shoulder movements of the individuals compared to fracture classification.

In measuring shoulder's range of motion, abduction was the most affected movement in all patients, with no group presenting a so-called functional range. For flexion movements, the Neer's 2-part fracture group showed a functional range (Table 2).

Active ROM normal/functional ⁽⁶⁾	Neer's 2 parts	Neer's 3 parts	Neer's 4 parts
Flexion 180°/120°	136°	101,3°	103°
Abduction 180°/120°	96°	80°	85°
External Rotation 70°/ 30°	59°	45,3°	48°

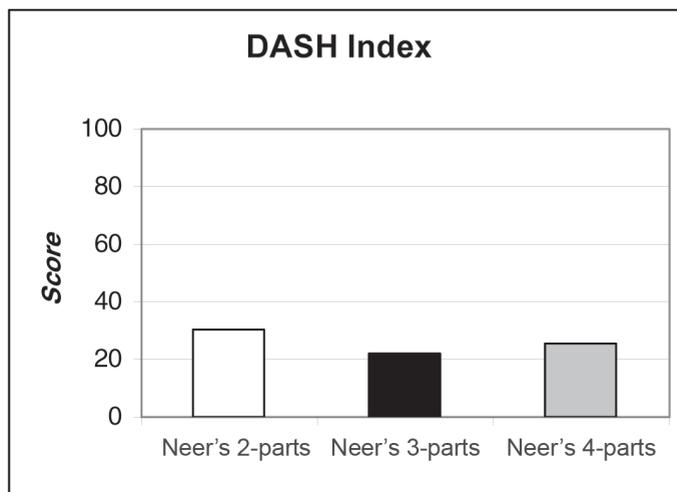
Table 2 – Averages of the results obtained from goniometry for individuals' angle movements at the most compromised degrees compared to fracture classification.

For Constant's questionnaire, the results were worse for the group with 2-part fractures, with an index close to 45, with the group with 3-part fractures showing better indexes (Graph 1).



Graph 1 – Average of results obtained from Constant's questionnaire for patients with proximal humerus fractures according to Neer's classification.

The functional DASH index showed a higher value for the two-part fracture group (30), and, again, the 3-part fracture group showed a better functional outcome (Graph 2).



Graph 2 – Averages of the results of the DASH index for patients with proximal humerus fractures according to Neer's classification.

DISCUSSION

The surgical treatment of comminutive fractures of the proximal humerus is associated to a high rate of complications (neurovascular injuries, pseudoarthrosis and osteonecrosis)^(2,3). Depending on the severity of injury, some authors choose to remove the humeral head followed by hemiarthroplasty when treating proximal humerus fractures due to the challenges in achieving a secure fixation^(12,13,14). The major dilemma when treating this kind of fracture is that an earlier mobilization is likely to lead to non-union, and a late mobilization can evolve to contracture and joint stiffness. In the early 1900's, closed reduction was the procedure of choice, with traction and plastered cast, promoting anatomical alignment, but, on the other hand, there was a considerable shoulder movement loss⁽⁶⁾. Recently, the plate with fixed-angle screws has been employed for the proximal region of the humerus, targeting a better injury stabilization by using this kind of osteosynthesis, which promotes a safe anatomic reduction, thus allowing an early mobilization of the fractured limb, enabling a better end functional prognosis for the affected limb⁽⁷⁾. In our study, the use of this kind of osteosynthesis model for the proximal humerus was shown to be safe, because there were no cases of postoperative reduction loss among the patients studied. Major factors that can interfere on the evolution of the functional picture of these patients' upper limbs involve fractures classification; associated soft parts injuries and the repair performed on these tissues, as well as fixation stability associated to bone quality⁽³⁾. Thus, a patient with a fracture in fewer parts, associated to smaller deviations, tends to present a better functional diagnosis if compared to a patient with great fracture comminution and deviation, which ultimately injure soft tissues more severely. The group with 4-part fractures showed, in average, a greater muscular strength loss on the upper limb. The group with 2-part fractures, although including a multiple-trauma subject, was the one showing the best results, probably due to the fact that other patients presented muscular strength values

close to normal⁽¹¹⁾. The use of goniometry for measuring the range of motion of patients' shoulders showed that flexion, abduction and external rotation movements were the most impaired ones. The results of the physical-functional evaluation showed that the group with 3-part fractures achieved better results both for Constant's questionnaire and for the DASH index. This may have occurred as a result of the homogeneity shown by this group, differently from the 2-part fractures group, which included a multiple-trauma patient, with a picture of associated tibial and femoral fractures, which led to a reduced average value for Constant's questionnaire and an increased DASH score, thus showing a greater functional loss. Assessing the results of DASH – a generic index for upper limbs dysfunction indicated for any pathology on this segment, no important functional loss was found among the studied cases, with dysfunction indexes between 20 and 30% for the three groups. On the other hand, when assessing the scores obtained from Constant's questionnaire, which is specifically designed for assessments of the shoulder joint, we found values suggesting an important functional loss in the three groups, but particularly to Neer's 2-parts group, with approximately 45% of shoulder function. It is expected that the more severe the injury, the greater the dysfunction. The studied groups showed different results, with more significant losses for the 2-part fractures group, justifiable for having included a patient carrying other sequels from associated fractures on upper and lower limbs.

CONCLUSION

Our data suggest the emergence of residual functional loss on upper limbs after this kind of trauma, despite of the stable fixation and the physical therapeutic treatment. The Constant's questionnaire was superior in demonstrating the functional loss of the shoulder joint complex.

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