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Original Article

Our clinical results in the management of proximal humeral fractures

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Abstract

Aim: The aim of this study was to evaluate the clinical, radiological and functional results of patients treated with different methods in our clinic for proximal humerus fracture.

Material and Methods: A total of 106 patients with a diagnosis of proximal humerus fracture, who were scheduled for treatment, received management and followed up periodically after discharge were included. Patient files, X-RAY radiographs in the PACS system, surgical notes and outpatient epicrisis were used. Functional results were evaluated according to Constant shoulder score at the last visit.

Results: The mean age of the patients was 53.6 years (17-94). The mean follow-up period was 11.3 months (6-40 months). 55 (51.9%) had Type II, 35 (33%) had Type III and 16 (15.1%) had Type IV proximal end humeral fractures. As a result of the evaluation performed at the last follow-up of the patients, Constant-Murley's total score was 64.50 out of 100 (31-88). Score distribution according to Neer classification of patients; A Constant-Murley score median with a Neer Type II fracture was 74.00 (36-88), a Constant-Murley Score median with a Neer Type III fracture was 61.00 (31-78), and a Constant-Murley score median with a Neer Type IV fracture was 44.50 (33-70).

Conclusion: When the fracture type and functional outcome of the patients were compared, functional outcome decreased as the fracture type increased. Young patients had better functional results than older patients.

Keywords: Proximal fracture of the humerus; neer classification; constant-murley score; functional results

INTRODUCTION

Proximal humeral fractures constitute 4-5% of all fractures. Humeral fractures usually require hospitalization and / or rehabilitation care (1). The frequency of proximal humerus fracture varies according to region and age. In addition to increased bone fragility caused by osteopenia or osteoporosis, commonly reported risk factors include; low physical activity, impaired balance, or lower extremity pain or injury, and those associated with an increased risk of falls (2). Different classification systems are available to describe fracture morphology. Neer uses a classification that divides the proximal humerus into 4 functional parts, whilst the AO classification uses a 3-category portion of A, B and C. Type A fractures are simple fractures, Type B fractures include surgical neck and Type C include anatomical neck (3). A treatment option consists of; non-operative treatment, minimally invasive osteosynthesis, open reduction and internal fixation with plate and screws, intramedullary nailing and primary arthroplasty (4).

MATERIAL and METHODS

After the approval of the non-invasive research ethics committee of Inonu Universty TOTM Medical center (20.12.2018 -21/22), patients who were admitted to the Orthopedics and Traumatology Clinic and Outpatient Clinic with the diagnosis of proximal humerus fracture between January 2010 and September 2018, , who were scheduled for treatment and received management were included in the study. Applicants admitted to the hospital within the specified date range; a total of 106 patients with proximal humeral fractures (55 male - 51 female) were included in

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the study. The fractures of the patients were evaluated with Neer and AO classifications. Functional evaluation was performed by using Constant-Murley Shoulder Scoring (CMS) at the last control visit. In the evaluation of functions, shoulder movements divided into categroies; abduction, flexion, extension, internal rotation and external rotation. Joint range of motion was measured with a goniometer. Preoperative risk assessment was performed by anesthesia clinic according to American Society of Anesthesiologists (ASA) criteria. X-RAY radiographs in the PACS system, surgical notes, and outpatient epicrisis were used to evaluate the patients.

Velpeau bandage was applied to the patients who were treated conservatively (Figure 1). Immobilization, ice and anti-inflammatory drugs were used to reduce pain and inflammation. In order to prevent edema in the distal part of the extremity; Hand-wrist joint range of motion (ROM) exercises were started and elbow ROM exercises were started in the first week. At the end of the first week, the arm sling was intermittently removed and the limb was supported with a pillow under the arm while the patient in sitting position. Also, pendulum exercises were added to wrist and elbow exercises this week.

Figure 1. Velpeau bandage

After the second week, assisted passive flexion and abduction movements were started with the exercises applied in the first two weeks. Active assisted ROM exercises were started in the fourth week. Stretching exercises were performed in the eighth week to gain full range of motion.

Deltopectoral incision was applied to the patients who underwent surgery and passive shoulder exercises, wrist and elbow exercises were started on the first postoperative day (Figure 2). Patients who had no wound problems were asked to have daily dressing after discharge. Sutures were removed on the 15th postoperative day. In addition to the initial exercises, active assisted shoulder exercises were described to the patients following suture removal. At the 4th postoperative week, patients who could not reach the desired range of motion of the shoulder joint were consulted to the physical therapy and rehabilitation polyclinic.

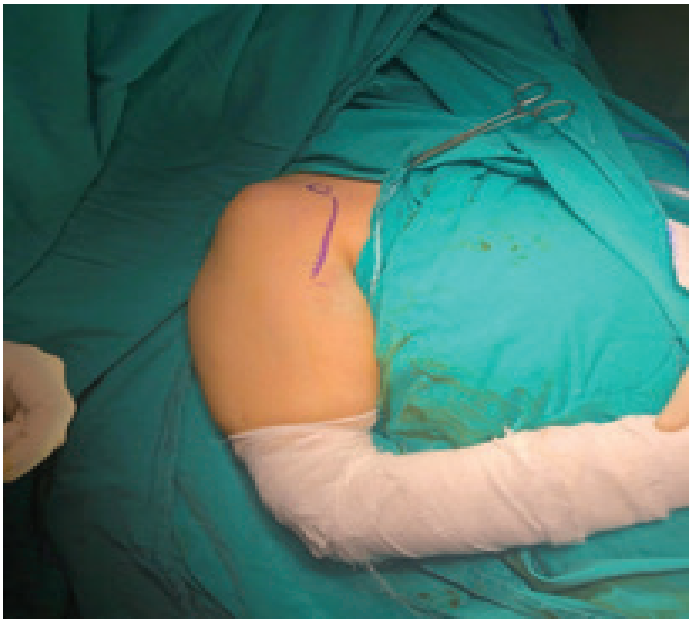

Figure 2. Deltopectoral incision

IBM SPSS Statistics Version 22.0 package program was used for statistical analysis of the data. Categorical measurements were summarized as numbers and percentages, and continuous measurements were summarized as mean and standard deviation (median and minimum - maximum where necessary). The Kolmogrov Smirnov test was used to test whether the continuous measurements provided the normal distribution assumption. The Mann Whitney U test was used to compare the continuous measurements that did not show normal distribution between the two groups. In the comparison of continuous measurements of more than two groups, one-way analysis of variance was used if the assumptions were met, and Kruskal Wallis test was used if the assumptions were not met. Pearson Correlation coefficient and related p value were obtained to examine the interaction of continuous measurements. Statistical significance was taken as 0.05 in all tests.

RESULTS

The distribution of 106 patients in the study according to gender was 55 (51.9%) male and 51 (48.1%) female. The mean age was 53.6 years (17-94). The mean follow-up period was 11.3 months (6-40 months). 53 patients had right and 53 patients had left proximal humerus fractures. Fifty-five patients (51.9%) had Type II according to Neer classification, 35 (33%) had Type III according to Neer classification, and 16 (15.1) had Type IV proximal end fractures of the humerus according to Neer classification. According to the Constant-Murley' scoring, the average of

the patients included in the study at their last visit was 64.50 (31-88) over a total of 100 points (Table 1). This result was considered good. Score distribution according to Neer classification; Constant-Murley score median of patients with type 2 fracture was 74.00 (36-88), Constant-Murley score median of patients with type 3 fracture was 61,00 (31-78) and Constant-Murley score median of patients with type 4 fracture was 44.50 (33-70). Functional outcome decreases as fracture type increases. The result was statistically significant (p <0.001) (Table 2).

Table 1. Mean Constant –Murley Score of patients

	N	Min	Max	$\bar{X}$	ss
Constant	106	31.00	88.00	64.50	1.460.341

Table 2. The relationship between Neer classification and Constant-Murley score

Type	N	Median	Min	Max
Type 2	55	740.000	36.00	88,.00
Type 3	35	610.000	31.00	78.00
Type 4	16	445.000	33.00	70.00
Total	106	64.5000	31.00	88.00

When the Constant-Murley scores of the patients in the Neer Type II group who were treated conservatively according to age range were evaluated; The median score of 5 patients between the ages of 17-29 was 80.00 (SD = 4.06), the median score of 10 patients between the ages of 30-49 was 75.10 (SD = 4.38), the median score of 13 patients between the ages of 50-69 was 69.38 (sd=6,26) and the median score of 7 patients over the age of 70 was 56.71 (sd = 8.99). Constant-Murley score median of 106 patients in the study, those treated conservatively and 35 patients with Neer Type II was 70 (45-84) (sd = 9.69). In this group, the relationship between age and Constant-Murley score was significant (P<0.05) (Table 3).

When Constant-Murley scores of patients treated with plate osteosynthesis due to proximal fracture of the humerus were evaluated; the median score of 34 patients was 62.00 (31-83). The score median of 4 patients aged 17-29 was 71.00 (64-83), the score median of 8 patients aged 30-49 was 64 (36-78), the score median of 14 patients aged 50-69 was 62.50 (38-75) and the median score of 8 patients over the age of 70 was 56.00 (31-64). The correlation between age and CMS was significant and negative in this group. The relationship was negative but the strength was moderate (P <0.05) (Table 4).

Constant-Murley score median of 27 patients in the Neer Type III class who underwent k-wire fixation and plate osteosynthesis treatment was 61.00 (31-78). While the

Table 3. Constant-Murley score difference according to the age range in Neer Type II group patients who managed conservatively

	N	Median	Ss	Min	Max	p
17-29 years	5	800.000	406.202	74.00	84.00	
30-49 years	10	751.000	438.305	68,.00	82.00	0.001
50-69 years	13	693.846	626.549	61.00	77.00	
>70 years	7	567.143	899.471	45.00	70.00	
Total	35	700.000	969.536	45.00	84.00	

CMS median of the 22 patients who underwent plate osteosynthesis was 62.50 (31-78), the median score of 5 patients who underwent k-wire fixation was 50.00 (36-55) (p <0.05). (Table 5).

In the study, CMS median of 35 patients in Neer Type II patients who underwent conservative treatment was 70.00 ± 9.69, whereas the median score of 6 patients who underwent plate osteosynthesis was 66.00 ± 16.67. In conclusion, there was no significant relationship between conservative treatment and plate osteosynthesis score in Neer Type II proximal humerus fractures (P> 0.05) (Table 6)

Of the 52 Neer Type II patients included in the study; Four patients underwent cannulated screw fixation and their Constant score was 65 ± 14.39, 35 patients were treated conservatively and Constant score was 70 ± 9.69. AVN developed in 7 (6.6%) of 106 patients in the study. The distribution of 7 patients with AVN according to Neer classification was as follows: 2 patients had Neer Type II fracture, 3 had Neer Type III, and 2 patients had Neer Type IV fracture. Subacromial impingement developed in 11 patients. 5 of these were Neer Type II, 4 were Neer Type III and 2 were Neer Type IV fracture. 4 patients had malunion. Three of these were Neer Type II and 1 was Neer Type III.

Table 4. Age-related Constant-Murley score difference in patients underwent plate osteosynthesis

Age range	N	Median	Min	Max	p
17-29 years	4	71.0000	64.00	83.00	0.033
30-49 years	8	64.0000	36.00	78.00	
50-69 years	14	62.5000	38.00	75.00	
>70 years	8	56.0000	31.00	64.00	
Total	34	62.0000	31.00	83.00	

Table 5. Constant-Murley score difference in patients with Neer Type III fractures who underwent plate osteosynthesis and K-wire fixation

	Treatment	N	Median	Min	Max
Constant	Plate	22	62.5000	31.00	78.00
	K wire	5	50.0000	36.00	55.00
	Total	27	61.0000	31.00	78.00

Partial shoulder prosthesis was applied to 1 patient in Neer Type III class and 2 patients with Neer Type IV classification. The mean CMS of these patients were 41.

Malunion occurred in 4 patients, nonunion in 5 patients, loss of reduction in 1 patient, and supraspinatus tear in 1 patient. Of the 106 patients included in the study, infection occurred in 4 patients (3.7%). One of the patients who underwent surgery developed early infection and three developed late infection. Of the 106 patients included in our study, nonunion developed in 6 patients. Two of these patients were followed conservatively and four of them had surgical treatment. These patients who developed nonunion problems had advanced age and additional comorbid diseases.

Table 6. Constant-Murley score difference in Neer Type II fractures (plate-conservative treatment)

	Treatment	N	Median	ss	p
Constant	Conservative	35	70.0000	9.69536	0.409
	Plate	6	66.0000	16.67333	

DISCUSSION

Proximal humeral fractures in fractures accounts for about 4 - 5% of all fractures. They are the most common fractures following hip and radius distal fractures as age progresses (1). Epidemiological studies show that approximately half of the fractures are low-level fractures (49%). The largest group included patients with 2-part fractures with 28%, followed by 3-part fractures (surgical neck, tuberculum major) with 9%. 4-part fractures constitute approximately 2% of proximal humeral fractures (5). The distribution of the patients in our study was similar to the literature according to Neer classification; 55 (51.9%) were Type II, 35 (33%) were Type III and 16 (15.1%) were Type IV.

Lill et al. (6) reported the CMS of 37 patients treated conservatively; excellent results reported in 10 patients and good results in 13 patients, and suggested that poor results were caused by painful joint movement and loss of strength. In our study, when the Constant-Murley score was evaluated according to the age range of the conservatively treated patients in the Neer Type II group; Median Constant-Murley score of 5 patients aged 17-29 years 80.00 (sd = 4.06), median Constant-Murley score of 10 patients aged 30-49 years 75.10 (sd = 4.38), The median Constant-Murley score of 13 patients between 50-69 years was 69.38 (sd = 6.26) and the median Constant-Murley score of 7 patients over 70 years was 56.71 (sd = 8.99). Of the 106 patients included in the study, The median of Constant-Murley score of 35 patients with Neer Type II who were treated conservatively was 70 (45-84) (sd = 9.69),. In this group, the relationship between age and Constant-Murley score was significant (P<0.001).

In our study, when we evaluated Constant-Murley score of patients treated with plate osteosynthesis for proximal fracture of humerus; A total of 34 patients had a Constant-Murley score median of 62.00 (31-83).). The score median of 4 patients aged 17-29 was 71.00 (64-83), the score median of 8 patients aged 30-49 was 64 (36-78), the score median of 14 patients aged 50-69 was 62.50 (38-75) and the median score of 8 patients over the age of 70 was 56.00 (31-64). The correlation between age and Constant-Murley score was significant and negative in this group. The relationship was negative but the strength was moderate (P <0.05). In this group,

the relationship between age and Constant-Murley score was found to be significant. Similar to conservative treatment, bone quality decreased with increasing age; We also concluded that Constant-Murley scores may have decreased due to concomitant illness and decreased patient compliance. According to Herscovici et al. (7), the use of minimally invasive methods such as closed reduction and percutaneous nailing, with good bone quality, is a more appropriate treatment approach in compatible patients and less fragmented fractures (91). In our study, the Constant-Murley score median of the 27 patients who underwent k wire fixation and plate osteosynthesis treatment in the Neer Type III class was 61.00 (31-78). While the Constant-Murley score median of the 22 patients who underwent plate osteosynthesis was 62.50 (31-78), the median score of 5 patients with k-wire fixation was 50.0 (36-55) ($p < 0.05$). The result was found to be significant. We believe that functional outcomes may be affected in patients with k-wire fixation due to possible early mobility difficulties and rehabilitation problems. In addition, in Neer Type III fractures; we believe that treatment with plate osteosynthesis can provide more reliable fixation compared to k-wire treatment method and this may enable early mobilization.

Cai et al. (8) argued that non-displaced or 2-part PHFs can typically be treated conservatively and that clinical outcomes are satisfactory. In our study, Constant-Murley score median of 35 patients with Neer Type II who were treated conservatively was 70.00 ± 9.69, whereas the median score of six patients who underwent plate osteosynthesis was 66.00 ± 16.67. In conclusion, no significant relationship was found between conservative treatment and score of plate osteosynthesis in Neer Type II proximal humeral fractures ($P > 0.05$). We believe that Neer Type II fractures can be treated conservatively in order to avoid cost and surgical risks.

Osteonecrosis, a complication of proximal humerus fractures, is known to be a result of disrupted nourishment of the humeral head, but its cause has not been clarified (9). In our study, the distribution of 7 patients with AVN according to Neer classification was 2 patients Neer Type II, 3 Neer Type III, and 2 Neer Type IV. Considering this distribution, we concluded that there may not be a strong relationship between fracture classification and AVN complication. Another complication is non-union risk fractures; those without cortical contact between the humeral head and shaft, and comminuted fractures (10). Complete disruption of the periosteal sheath causes instability and soft tissue interposition may inhibit callus formation (11). Of the 106 patients in our study, nonunion developed in 6 patients. Two of these patients were followed conservatively and four of them had surgical treatment. These patients who developed nonunion problems had advanced age and additional illness. In this case, we think that age, general condition and additional disease factors may be important along with the type of fracture in terms of union problems. Infection after osteosynthesis with locked plate is a complication. Egol et al. (12,14) reported acute infection developed in 1 patient in a series of 51 cases. Gardner et al. (13,15,16) showed superficial infection in 1 patient.

The indications to treat a proximal humerus fracture nonoperatively, with surgical fixation, or with arthroplasty, are still evolving (17-22). In the past, much of the treatment algorithm was based on radiographs and fracture classification systems (23-26).

Some indications for surgery are more straightforward. Patients who have sustained an open fracture, vascular injuries, or those that have repairable neurologic injuries are usually indicated for acute operative intervention (27-30).

Of the 106 patients included in our study, infection developed in 4 (3.7%) patients who underwent surgery. One of the patients who underwent surgery developed early infection and three developed late infection. The patient developed early infection and was treated by washing and debridement in the early period. Diabetes mellitus was present in 3 of the patients who developed late infection. Of them; Plate osteosynthesis was performed in 2 patients and partial shoulder prosthesis was performed in 1 patient. Repeated washing, debridement and antibiotic spacer were applied to the patients and the plate was removed following fracture union. We think that the presence of concomitant disease such as diabetes mellitus may be important in the development of infection in patients undergoing open surgery.

CONCLUSION

We can say that the incidence of proximal fractures of the humerus may increase in the following years with the prolongation of survival. A standardized and generally accepted treatment protocol for the treatment of proximal humeral fractures is currently unavailable. First of all, the type and morphology of the fracture should be well defined and classified. Non-displaced or slightly displaced fractures can be treated conservatively. When choosing treatment for displaced 2 or 3-part fractures, patient expectations and treatment compliance should be considered. Regardless of the choice of treatment, appropriate assessment of the fracture, adequate information for the patient, a rigorous surgical technique, and a focused and personalized rehabilitation are the basis for the success of clinical management of these fractures.

Competing interests: The authors declare that they have no competing interest.

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Ethical approval: After the approval of the non-invasive research ethics committee of Inonu University TOTM Medical center (20.12.2018 -21/22), patients who were admitted to the Orthopedics and Traumatology Clinic and Outpatient Clinic with the diagnosis of proximal humerus fracture between January 2010 and September 2018, , who were scheduled for treatment and received management were included in the study.

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