International Orthopaedics (SICOT) (2004) 28:231–234
DOI 10.1007/s00264-004-0552-3

ORIGINAL PAPER

Selçuk Keser · Selçuk Bölükbaşı · Ahmet Bayar · Ulunay Kanatlı · Jale Meray · Hakan Özdemir

Proximal humeral fractures with minimal displacement treated conservatively

Accepted: 11 February 2004 / Published online: 13 March 2004

Abstract We reviewed 27 patients with a minimally displaced proximal humeral fracture treated conservatively after a mean follow-up of 25 (12–34) months. All fractures had united. Patients were evaluated using the Constant-Murley scoring system, and isokinetic muscle strength was tested using a Cybex dynamometer. Finally, all shoulders were examined ultrasonographically. The mean Constant score for all patients were 81 (54–100). Twenty-three patients had no or only mild pain, while three had moderate and one severe pain necessitating regular use of oral analgesics. Twenty patients were able to perform all activities of daily living, but seven had mild trouble in overhead activities and weight carrying. Only in one patient, the abduction peak torque equalled the one of the opposite shoulder. In all other patients, the peak torque was lower than, and in 14 patients below, 50%. In nine patients, rotator cuff tears were seen at ultrasonography.

Résumé Nous avons examiné 27 malades avec une fracture humérale proximale peu déplacée traitée d'une manière conservatrice après un suivi moyen de 25 (12–34) mois. Toutes les fractures avaient consolidé. Les malades ont été évalués avec le score de Murley Constant et la force musculaire isokinetique a été testée par un dynamomètre Cybex. Toutes les épaules ont été examinées par échographie. Le score de Constant moyen pour tous les malades était de 81 (54–100). Vingt-trois malades n'avaient aucune douleur ou des douleurs très discrètes, trois avaient des douleurs modérées et une patiente avait des douleurs sévères nécessitant l'usage régulier d'analgésiques oraux. Vingt malades étaient capables d'exécuter toutes les activités de la vie quotidienne mais sept avaient des difficultés pour les activités en hauteur et pour le port de charges. Chez seulement un patient la force d'abduction maximum était égale à celle de l'épaule opposée, pour tous les autres malades elle était inférieure et chez 14 d'entre eux elle était même à moins de la moitié. Chez neuf patients une déchirure de la coiffe des rotateurs était visible à l'échographie.

S. Keser (✉) · A. Bayar
Department of Orthopaedics and Traumatology,
Karaelmas University Medical School,
67600 Kozlu, Zonguldak, Turkey
e-mail: selkeser@hotmail.com
Tel.: +90-372-2610170
Fax: +90-372-2610155

S. Bölükbaşı · U. Kanatlı
Department of Orthopaedics and Traumatology,
Gazi University Medical School,
Ankara, Turkey

J. Meray
Department of Physical Medicine and Rehabilitation,
Gazi University Medical School,
Ankara, Turkey

H. Özdemir
Department of Radiology,
Gazi University Medical School,
Ankara, Turkey

Introduction

Studies on proximal humeral fractures usually focus on the management of displaced fractures. There has been much less interest on minimally displaced fractures, since they are generally accepted to have a good prognosis [1, 6, 11]. We studied minimally displaced proximal humeral fractures and provide a detailed analysis of the functional outcome.

Patients and methods

We evaluated retrospectively 64 adult patients with proximal humeral fractures treated conservatively between 1995 and 1999. As described by Neer [11], fractures that had less than 45° angulation and less than 1 cm displacement between the major fragments were considered to be minimally displaced. Patients with previous shoulder problems and patients with fracture dislocations were excluded. Out of 32 patients, five were not able to co-operate with isokinetic muscle-strength testing. The study therefore finally included 27 patients with a mean age of 51 (25–75) years who had sustained a simple fall or a traffic accident.

Fig. 1 Positioning of subject for shoulder abduction/adduction

There were 14 women with a mean age of 55 years and 13 men with a mean age of 41 years. Sixteen patients were younger than 60 years of age. In all patients, the right extremity was dominant, and in 12, the fracture involved the right shoulder. Fifteen fractures showed only a single fracture line, of which seven involved the surgical neck and eight the greater tubercle. Twelve fractures showed multiple fracture lines.

The fractured arm was immobilised and oral non-steroidal anti-inflammatory drugs were prescribed. As soon as the pain permitted, passive exercises of the shoulder together with active exercises of the elbow and wrist were started under supervision of a physiotherapist. After active range of motion (ROM) had been regained, isometric strengthening and then resistive exercises were added. A forceful stretching programme was initiated 12 weeks after the fracture.

At the final follow-up, all patients were evaluated according to the Constant and Murley scoring system [3]. Instead of spring-balance testing of strength, we modified the system by introducing the concept of isokinetic testing. Measurement of muscle strength was done using the Cybex-Norm dynamometer (Cybex, Inc., Ronkonkoma, NY, USA). Peak torque values of abduction and adduction were obtained for both fractured and non-fractured shoulders. Peak torque values of non-fractured shoulders were accepted as 25 points, and the fractured shoulders were scored proportionately. Measurements of deltoid and supraspinatus muscles are especially important to evaluate shoulder strength.

Prior to isokinetic testing, calibration was performed via standard weights. The position of the patient and dynamometer was settled according to standard measurement technique, i.e. dynamometer was tilted 30°, rotated 10° and elevated 13°. After the seat belt had been fastened, length of the adaptor was settled at 90° abduction of the shoulder. This brought the axis of dynamometer and the axis of glenohumeral joint to the same projection for abduction. ROM was limited mechanically at 0° and 90° (Fig. 1). The unaffected shoulder was tested initially. After co-operation had been established with four trials, real testing was performed using 60°/s angular velocity.

In order to evaluate the rotator cuff tendons, impingement tests were performed (subacromial tenderness, impingement sign I, II and painful arc), which were followed by ultrasonography (US) with a 7.5–10.0°MHz "linear array" transducer (General Electric Logic 700 MR) of both shoulders. US was carried out in the sitting position with the patient facing the examiner. Muscular and tendinous structures were evaluated at both transverse and longitudinal planes. While the presence of focal hypoechoic zones inside tendons and a decrease in the width of cuff characterised partial tears, visualisation of tear ends or a segmental loss of tendon structure were the criteria to diagnose complete tears [8]. The results were classified as excellent, good, moderate and poor according to pain, daily activities including ROM and isokinetic muscle strength (Table 1). SPSS version 11 was used for statistical analysis. Mann-Whitney *U* test was utilised to compare the means of groups.

Results

The mean follow-up period was 25 (12–34) months. All fractures were united without displacement. While 17 patients had no pain, six had mild pain that did not interfere with routine activities. Pain was moderate in three patients, and only one had severe pain that necessitates regular use of oral analgesics. Twenty patients were able to perform all activities of daily living, and seven had mild trouble in overhead activities and weight carrying. At the latest follow-up, mean ROM of all fractured shoulders reached 90% of the non-fractured side.

Peak torque deficit in abduction in patients older than 60 years of age was found to be significantly higher than in patients younger than 60 years ($p<0.05$). In the older age group, the mean Constant score was significantly lower than in the younger group ($p<0.05$). There was no significant difference between peak torque deficits in patients having the fracture on the dominant side and non-dominant sides. Isokinetic test results revealed that the number of fractured shoulders that had reached 75–100%, 50–74%, 25–49% and <24% of abduction peak torque strength of contralateral shoulders were four, nine, ten and four respectively. Only in one patient did the fractured shoulder reach the same peak torque in abduction as the opposite one. For adduction, on the other hand, peak torque values of the fractured shoulders were close to the values of the non-fractured shoulders.

Mean Constant score was 81 (54–100). Statistical analysis revealed that, dominance and fracture geometry had no significant effect on scores of pain, activities of daily living, ROM, isokinetic test results of abduction or overall Constant score. In five patients with complete rotator cuff tears as diagnosed with US, clinical impingement signs

Table 1 Classification of results. *ADL* activities of daily living, *ROM* range of movement

	Pain	ADL and ROM	Isokinetic muscle strength
Excellent	None	>90%	75–100%
Good	Mild	80–89%	50–74%
Moderate	Moderate	70–79%	25–49%
Poor	Severe	<70%	<25%

Table 2 Results in patients with complete rotator cuff tears. *ROM* range of motion

Patient	Age	Gender	Pain	Function	ROM	Muscular strength	Constant score	Abduction peak torque deficit %
1	72	Male	5	12	32	6	54	84
2	58	Male	5	20	34	4	62	87
3	63	Female	10	20	34	10	74	80
4.	60	Female	10	18	24	9	71	72
5.	67	Female	0	8	26	4	38	90

Table 3 Results in patients with partial rotator cuff tears. *ROM* range of motion

Patient	Age	Gender	Pain	Function	ROM	Muscular strength	Constant score	Abduction peak torque deficit %
1	44	Male	15	20	40	19	94	28
2	54	Female	10	20	30	14	74	64
3	42	Male	15	20	40	12	87	55
4	41	Male	5	14	28	14	61	51

were also positive. In patients with partial tears, impingement signs were only positive in one out of four. Data about patients with tears are given in Tables 2 and 3.

Overall, the results were graded as excellent in 11 patients, good in nine, moderate in five and poor in two. While 16/17 patients without pain had good or excellent results, the ratio for those with pain was only 4/10. The ratio of good and excellent results for those with and without cuff tears were 3/9 and 17/18 respectively.

Discussion

Minimally displaced fractures of the proximal humerus are generally known to have low morbidity and high patient satisfaction after conservative treatment. Studies have generally yielded excellent results. Kristiansen and Christensen [7], Mills and Horne [9] and Young and Wallace [13] reported 94%, 95% and 97% good and excellent results respectively. However, in a detailed analysis by Koval et al [6], good and excellent functional healing rate was only 77%. Re-trauma and pre-existing cuff diseases were the major causes of deterioration. According to our evaluation system, which incorporated Cybex test results and Constant and Murley scoring, the ratio of good and excellent results was rather low (74%), which is in accordance with the study of Koval et al. [6]. When only the muscle strength of fractured shoulders was taken into account, the results were even more unsatisfactory. Only 13 patients reached a muscle strength of 50% or higher. Muscular weakness was significantly more pronounced in patients older than 60 years of age.

In the different series, there are various methods of evaluation. Usually, data on muscle strength has been neglected. Our study is the first to include Cybex isokinetic measurements in the study of proximal humeral fractures with minimal displacement. We experienced that some shoulders that were thought to have normal muscular strength with manual testing indeed had a significant muscular weakness when tested with Cybex. Dominance did not affect Cybex measurements in different age and gender groups and life styles in healthy people [2, 4, 10]. Our findings support the data from Koval et al. [6] that, dominance did not affect the overall results after minimally displaced proximal humeral fractures. Our results are also in agreement with the study of Koval et al, that fracture geometry was not a significant factor [6]. Our study also revealed that, although the shoulders were painless, functional and strong enough for daily living, they had serious loss of muscular strength, which was more pronounced in the older age group. This was in contrast to Koval et al., who reported that age was not a major determinant for final outcome [6].

Co-existence of proximal humeral fractures and rotator cuff tears were identified. Rotator cuff tears may accompany displaced fractures [11]. In a study by Kim et al. [5], partial cuff tears were documented with arthroscopy in 23 patients suffering from chronic shoulder pain 6 months after minimally displaced tuberculum majus fractures. Rotator cuff tears were the major cause of painful shoulders in our study. Since asymptomatic cuff tears are rather frequent in advanced age groups [12], it is not possible to establish the timing of the tears. The patients might have had a silent cuff tear before the trauma, or the tear might have occurred together with the fracture. Whatever the mechanism of the tear, it seems to be a detrimental factor. Treating physicians should consider the possibility of a cuff tear when the patient fails to proceed in rehabilitation or the standard therapy programme ends in a painful shoulder.

References

1. Bigliani LU, Flatow EL, Pollock RG (1998) Fractures of the proximal humerus. In: Rockwood and Matsen (eds), The shoulder, 2nd edn, Saunders, Philadelphia, pp:337–389
2. Cahalan TD, Johnson ME, Chao EYS (1991) Shoulder strength analysis using the cybex II isokinetic dynamometer. Clin Orthop 271:249–257
3. Constant CR, Murley AHG (1987) A clinical method of functional assessment of the shoulder. Clin Orthop 214:160–164

4. Gallagher MA, Zuckerman JD, Coumo F, Ortiz J (1996) The effect of age, speed and arm dominance on shoulder function in untrained men. J Shoulder Elbow Surg 5:25–31
5. Kim SH, Ha KI (2000) Arthroscopic treatment of symptomatic shoulders with minimally displaced greater tuberosity fracture. Arthroscopy 6:695–700
6. Koval KJK, Gallagher MA, Marsicano JG (1997) Functional outcome after minimally displaced fractures of the proximal part of the humerus. J Bone Joint Surg [Am] 79:203–207
7. Kristiansen B, Christensen SW (1987) Proximal humeral fractures; Late results in relation to classification and treatment. Acta Orthop Scand 58:124–127
8. Mack LA, Matsen FA, Kilcoyne RF, Davies PK, Sickler ME (1985) US evaluation of the rotator cuff. Radiology 157:205–209
9. Mills HJ, Horne G (1985) Fractures of the proximal humerus in adults. J Trauma 25:801–805
10. Murray MP, Gore DR, Gardner GM, Mollinger LA (1985) Shoulder motion and muscle strength of normal men and women in two age groups. Clin Orthop 192:268–273
11. Neer CS (1970) Displaced proximal humeral fractures; Part I. Classification and evaluation. J Bone Joint Surg [Am] 52:1077–1089
12. Tempelhof S, Rupp S, Seil R (1999) Age-related prevalence of rotator cuff tears in asymptomatic shoulders. J Shoulder Elbow Surg 8:296–299
13. Young TB, Wallace WA (1985) Conservative treatment of fractures and fracture-dislocations of the upper end of the humerus. J Bone Joint Surg [Br] 67:373–377