Non-operative treatment versus tension-band osteosynthesis in three- and four-part proximal humeral fractures

A retrospective study of 34 fractures from two different trauma centers

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Summary. *Thirty-four patients with three- and four-part proximal humeral fractures from two different trauma centres were studied retrospectively. Sixteen were treated without osteosynthesis and compared with 18 patients treated with tension-band fixation. Fracture classification and clinical examination were made by the same persons in both groups. Most of the three-part fractures healed with good pain relief and good function in daily life but often with a loss of motion. Four-part fractures often led to pain, loss of motion and of function. Conservative treatment seemed superior to tension-band fixation for three-part fractures. Four-part fractures healed with better function and range of motion after tension-band fixation.*

Résumé. *Trente-quatre patients présentant une fracture à trois ou quatre fragments de l'extrémité proximale de l'humerus ont été examinés rétrospectivement. Seize d'entre eux avaient été traités sans ostéosynthèse et comparés avec dix-huit patients stabilisée par haubannage. La classification des fractures ainsi que l'examen clinique des deux groupes ont été effectués par les mêmes personnes. Le plus grand nombre des fractures à trois fragments ont guéri avec une bonne disparition des douleurs, une bonne fonction dans la vie quotidienne mais avec une perte de mobilité. Les fractures à quatre fragments présentent des séquelles fréquentes telles que douleur et perte de fonction et de mobilité. Un traitement non stabilisateur semble supérieur à l'ostéosynthèse par haubannage pour les fractures à trois fragments. Les fractures à quatre fragments ont guéri avec une meilleure fonction et une meilleure mobilité lorsqu'elles ont été traitées par ostéosynthèse.*

Introduction

Three- and four-part proximal humeral fractures are typical but rare fractures of the elderly. There is no consensus concerning treatment. Non-operative treatment [8], transcutaneous fixation with Kirschner wires [4], tension band osteosynthesis [9], other types of osteosyntheses [7], and the primary implantation of a prosthesis [10] are suggested. In joint-preserving procedures, avascular necrosis of the humeral head is frequent, with subsequent pain, poor function, and a decreased range of motion. The prosthesis often leads to good pain relief but with a loss of motion and function.

For ethical reasons, randomization of operative treatment versus non-operative treatment is hardly possible in the same hospital. Studies on non-operative treatment are rare. Furthermore, the classification of these fractures has a low reproducibility which may partly explain the controversy about management [12, 13].

We compared the results of two trauma centres with different attitudes in treating these fractures. At the University Hospital in Lund, Sweden, three- and four-part proximal humeral fractures were treated without osteosynthesis, whereas in Kantonsspital Liestal, Switzerland, they were treated with tension-band fixation. The aim of our study was to compare the two types of treatment.

Patients and methods

Radiographs in at least two planes were available for all the patients in the study. One of the authors (PO) reviewed and classified all the radiographs with no knowledge of the clinical results. The fractures were classified according to Neer [10] into three-part fractures, four-part fractures, and fracture dislocations. Following the radiographic review, all the radiographs

Table 1. Clinical rating

	Pain	Function	Motion
1	Always	No use	Stiff
2	Sometimes severe	Severely handicapped	Severely reduced
3	Sometimes slight	Little handicap	Little reduced
4	No	Full	Symmetrical

in the non-stabilized group were judged suitable for treatment with tension-band fixation. The judgement was made by one of the authors (PO), based on the criteria for fixation as used in Liestal.

A simple score (Table 1) was used to rate pain, function, and motion. The lowest score was 3, the highest possible 12. All patients were examined by one of the authors (TI), and 12 of the patients from Liestal were re-examined by a second author (PO) to obtain the long-term results. The follow-up radiographs were all described by a radiologist with regard to

union, dislocation, and necrosis of the humeral head. The Mann-Whitney U-test was used in the statistical analysis.

At the University Hospital Lund in Sweden, 23 patients were treated for three- or four-part fractures of the proximal humerus between 1984 and 1989. Six fractures were judged by the orthopedic surgeons in charge as having a dislocated humeral head and were therefore reduced using general anesthesia; two of them needed an open reduction. All were mobilized after a few days. Two fractures were later stabilized with a Rush pin and thus excluded from the study. Two patients died, 2 patients were lost to follow-up, and 1 declined a follow-up examination. The remaining 16 patients were examined clinically in 1992 and radiographically 11. The mean follow-up was 70 (38 to 101) months, the mean age was 70 (23–91) years. Seven were classified as three-part, 9 as four-part fractures, and 5 were fracture dislocations (Table 2).

In the Kantonsspital Liestal in Switzerland 22 patients with three- and four-part proximal humeral fractures were treated with tension-band fixation between December 1984 and 1988. The early results were presented in a previous study and the

Table 2. Patient, age, sex, and classification of the fracture according to Neer (three-, four-part, and dislocation: -dis). Time to follow-up (months), rating of pain, function, and motion (see Table 1) and necrosis of the humeral head (yes/no)

Patient	Age	Sex	Comment	Neer	Reduction	Months	Pain	Function	Motion	Necrosis	Comment
Conservative group, Lund											
CT	23	m	Mentally ill	4-dis	Open	61	4	3	3	y	
BA	35	m		4-dis		38	2	4	3	n	
EA	65	f		4-dis	Closed	88	4	4	3	y	
GG	78	f		4-dis	Open	62	3	2	2	y	
MM	79	f		4-dis		58	4	2	2	•	
GP	75	f	Plexus palsy	4	Closed	73	2	2	3	y	Almost full regression
SÖ	77	f	Hip fracture	4		51	2	3	2	•	
AJ	83	f		4		92	1	2	1	y	
AiJ	91	f	Dementia	4		59	1	1	1	y	
GS	57	m	Rheumatoid arthritis	3	Closed	61	4	2	2	n	Secondary prosthesis
GL	64	f		3	Closed	64	4	4	4	n	
KL	72	f		3		69	4	4	3	y	
MS	75	f		3		77	4	3	2	•	
AT	77	f	Rheumatoid arthritis	3		101	4	4	4	•	
IS	81	f		3		96	4	4	3	n	
AA	84	f		3		62	3	4	3	•	
Operated group, Liestal											
DR	30	m		4-dis	Open	60	4	4	3	n	
PF	39	m		4-dis	Open	60	3	4	3	y	
HA	70	f		4-dis	Open	47	1	1	1	y	Prosthesis
KH	46	f		4	Open	82	2	3	2	y	
SF	55	f		4	Open	73	2	3	2	y	Late necrosis
MR	63	f		4	Open	95	3	4	4	n	
RiH	67	f		4	Open	52	4	4	3	y	
NS	68	m	Wound infection, Weakness in the hand	4	Open	33	2	2	2	n	Recovery, periarticular ossification, secondary prosthesis
LM	75	f		4	Open	36	2	2	2	y	
FM	79	f		4	Open	25	4	4	4	n	
KF	76	f		3-dis	Open	80	4	4	4	n	
FE	69	f		3-dis	Open	89	4	3	2	y	
WK	80	f		3	Open	48	2	3	3	y	
HE	23	m		3	Open	87	4	4	4	n	
GK	44	m	Infection	3	Open	33	1	2	2	n	Arthrodesis
SL	68	f		3	Open	96	4	2	2	n	
RuH	68	f		3	Open	47	1	2	2	y	Arthrodesis, later refracture
EB	69	f		3	Open	87	4	3	4	n	

treatment described in detail [11]. Two patients died, and 1 alcoholic and 1 mentally-ill patient declined further examination. The remaining 18 patients were clinically and radiographically examined in 1989; 12 were re-examined 1993. The mean follow-up was 63 (25 to 96) months, the mean age was 61 (23–80) years. Eight were classified as three-part fractures, 10 as four-part fractures, and five were fracture dislocations (Table 2).

Results

The results of both groups are shown in Table 2. In the non-stabilized group, 1 patient (GG) had arterial bleeding during the open reduction, which was stopped by compression. No other complications were recorded. After tension-band fixation, there were 2 infections and 1 case of periarticular ossification.

There was no difference regarding age, sex, and severity of injury between the non-stabilized and the tension-band group. The mean follow-up of the non-stabilized group was slightly longer. The overall clinical result of all fractures in both methods of treatment was very similar; the rate of humeral head necrosis seemed higher without osteosynthesis.

Table 3. The results of treatment in 3- and 4-part fractures

	Tension band	No osteosynthesis
3-part		
Number	8	7
Mean age	62 (23–80)	73 (57–84)
Dislocated	2	0
Mean pain	3.0	3.9
Mean function	2.9	3.6
Mean motion	2.9	3.0
Head necrosis	3 (of 8)	1 (of 4)
4-part		
Number	10	9
Mean age	59 (30–79)	67 (23–91)
Dislocated	3	5
Mean pain	2.7	2.6
Mean function	3.1	2.6
Mean motion	2.6	2.2
Head necrosis	6 (of 10)	6 (of 7)

Without osteosynthesis, three-part fractures healed with good pain relief and function. A certain loss of motion remained. The results for three-part fractures were better than for four-part fractures (pain $P=0.026$, function $P=0.049$, motion $P=0.069$, necro-

Fig. 1. Example of non-operative treatment. This dislocated four-part fracture in a 65-year-old woman (EA) was treated with closed reduction and immobilized for 10 days, followed by a collar-cuff bandage for 3 weeks. Seven years later there was a partial necrosis of the humeral head. She had no pain in the shoulder, no limitations in her daily life, and only little reduction in the range of motion

Fig. 2. Example of tension-band osteosynthesis. This 67-year-old woman (RiH) fell on her left arm. She had a four-part fracture without dislocation which was treated with tension-band osteosynthesis. At 4.5 years later she had no pain, no limitations in her daily life, and only little reduction in the range of motion. The severe humeral head necrosis was diagnosed

as early as 2.5 months after injury. On the latest radiograph, 4.5 years after the injury, the cerclage wires were broken and one wire had migrated. There were only slight degenerative changes in the gleno-humeral joint

Fig. 3. Example of tension-band osteosynthesis. This 30-year-old man (DR) was in a traffic accident with multiple fractures. Six days after the initial treatment of the lower-limb injuries, the dislocated four-part fracture was treated with open reduction and tension-band osteosynthesis with PDS threads and additional K-wires. The K-wires were removed after 6 weeks. Five years after the injury there was no humeral head necrosis, he had no pain, no limitations in his daily life, and little reduction in the range of motion

sis $P=0.055$). Most four-part fractures had poor function and mobility (Table 2). All but 1 of 7 radiographically controlled four-part fractures developed necrosis of the head, but some of them had a good clinical outcome (Table 3, Fig. 1).

With tension-band osteosynthesis we found no difference between three- and four-part fractures. For the three-part fractures, the non-stabilizing treatment seemed to be better than the tension-band osteosynthesis for pain and function. The operated shoulders had a higher rate of osteonecrosis, but in the operated group there were two fracture-dislocations (Tables 2 and 3). For the four-part fractures, tension-band osteosynthesis seemed to improve function and motion and reduce the number of osteonecrosis as compared with the non-stabilizing treatment (Tables 2 and 3, Figs. 2 and 3).

For both methods of treatment, the development of necrosis impaired the mean clinical outcome (pain $P=0.046$, function $P=0.10$, motion $P=0.01$), even though it was well tolerated by single patients. All fractures with impaction in valgus remained stable, whereas for the others there was a tendency to heal in varus [5].

Discussion

Stableforth [14] compared the non-operative treatment of four-part fractures with the primary implantation of a Neer prosthesis in a randomized and prospective study and found a clear improvement in the clinical results with the prosthesis. Other authors describe a poor range of motion and aseptic loosening after joint replacement and recommend joint-preserving procedures, especially for the younger patients [4, 7, 15]. Using the prosthesis as a second intervention for failed osteosynthesis, good pain relief but poor results regarding range of motion and function are reported [3, 14]. We tried to improve the clinical and radiographical reliability of our observations. One experienced observer classified all fractures, which is assumed to reduce the inter- and intraobserver errors [12]. Another person, not involved in the treatment of the patients in question, evaluated the clinical outcome of most of the patients with a simplified score system [14].

At least two radiographic projections were available for each shoulder, sufficient for classification [13]. Both groups were comparable in number, severity of injury, and time of follow-up. The 2 patients excluded from Lund with unstable fracture dislocations stabilized with a Rush pin, had a poor prognosis, and might have impaired the overall results of the non-stabilized group. Patients seem to adapt well to the damaged shoulder in daily life, in spite of poor objective results. Necrosis after 2 years is rare, and we do not expect further complications. Because of missing radiographs in the non-stabilized group, statistical comparison of the rate of osteonecrosis is not valid.

For three-part fractures, the results in the conservative group were slightly superior. Two patients who underwent an operation were excluded; the number of patients was generally low and the differences not significant. Complete recovery was rare; most of our fractures healed with loss of motion. The conservative group, of course, had less complications, and the patients with complications in the operated group had a poor outcome. Our results are similar to the results of Leyshon [8] and Zyto et al. [16], who conclude that satisfactory results can be achieved by closed treatment in three-part fractures.

Four-part fractures are a clinical challenge, often leading to poor function and range of motion [8, 14]. There is a high risk of osteonecrosis because of damages to the vascular supply of the dislocated head fragment [1, 2]. In accordance with the literature, we found poor results for four-part fractures treated without osteosynthesis. In the series treated with tension-band osteosynthesis, the rate of osteonecrosis was lower with better function and range of motion. The differences, however, were not significant. The fear of necrosis of the humeral head is no argument against tension-band osteosynthesis [6].

In four-part fractures of the proximal humerus, tension-band osteosynthesis as a minimal internal fixation can improve the clinical outcome. The technique is demanding for the surgeon and requires extensive rehabilitation for satisfying results.

Our study affected the treatment in both hospitals. In Lund, four-part fractures in elderly patients are now often treated with a prosthesis. In Liestal, most of the three-part fractures are now treated closed. Four-part fractures are treated with tension-band osteosynthesis if the head is impacted in valgus. For elderly patients with severe dislocation, a prosthesis is considered.

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