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ORIGINAL ARTICLE

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Displaced scapular fractures: indication and long-term results of open reduction and internal fixation

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Abstract Displaced scapular fractures are often found in polytraumatized patients. In emergency treatment they assume a minor role. Advances in dealing with severely injured patients in most instances allow us to perform an operation on the fractured scapula within the first 2 weeks after injury. A differentiated approach is necessary as exclusively conservative treatment does not always bring about good results. From 1981–1991 we performed open reduction and internal fixation (ORIF) in 25 patients with displaced fractures of the scapula. The long-term results could be assessed in 20 patients after an average of 6.1 years. The different types of fractures were classified according to Habermeyer/Ideberg, and the Constant score was used in the evaluation of results. Some 64% of patients were involved in road accidents, and 64% suffered concomitant injuries. Articular fractures ($n = 6$) were the most common ones, followed by fractures of the coracoid process ($n = 5$) and the neck of the scapula ($n = 2$). There was no early postoperative complication, and follow-up showed a breakage of K-wires in one patient (fracture of the acromion). Thirteen patients obtained a very good, two patients a good, four a fair and one a poor result (according to the Constant score). Fractures of the scapular neck had the best results in terms of pain, daily activity, range of motion, and strength) as compared with fractures of the glenoid and apophyseal fractures. The radiological evaluation of the articular fractures showed advanced arthrosis of the glenoid with a discrepancy of the surface of more than 2 mm in one patient and a moderate arthrosis (first degree) with an intra-articular displacement of less than 2 mm in another one. The remaining four patients were free of articular incongruencies and other signs of arthrosis. In this retrospective study of operatively treated patients with displaced scapular fractures, more than 70% achieved very good or good results. In severely injured patients, the diagnosis of scapular fractures should be carefully excluded. Timely detection by radiography and computed tomography is mandatory for judicious decision-making concerning conservative and operative treatment.

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Introduction

Fractures of the scapula constitute only 1% of all osseous injuries, whereas there is a substantial rise to 5%–10% in polytraumatized patients [3, 13]. The predominantly massive and direct force producing this type of injury is most often found in high speed road accidents (60%–70%), and results in a high degree of concomitant injuries. In terms of urgency of treatment, fractures of the scapula rank low. A late or missed diagnosis is frequent and adds to the number of conservativley treated patients [1, 3, 9].

A more deliberate approach to the recognition and management of this injury is necessary, however, as especially fractures involving joint surfaces or the acromioclavicular joint may result in a loss of shoulder function [1, 3]. Along with technical refinement of diagnostic tools, more attention is being paid to scapular fractures as demonstrated by the rising number of publications on this subject.

Materials and methods

Between 1981 and 1991, 25 patients with displaced fractures of the scapula were treated by open reduction and internal fixation (ORIF) in the Department of Traumatology of the University of Ulm. The follow-up of 20 patients ranged between 1 and 11 years (mean 6.3 years). Their average age was 36.4 years (range 16–69 years). Five patients could not be included in the evaluation because of death, unknown address, or failure or refusal to return for examination.

In 16/25 patients (64%) a traffic accident was the cause of injury; 64% of patients suffered concomitant injuries (Table 1). The distribution of the different fracture types is listed in Table 2. The classification of Habermeyer/Ideberg was used.

Table 1 Data of patients

Patient; sex (age)	Diagnosis	Mechanism of injury	Associated injuries	Operative delay (days)	Technique of operation	Surgical approach	Follow-up
1; f (69 years)	Ideberg I fracture (left side)	Fall	None	7	Osteosynthesis with screws	Ventral	Yes
2; m (40 years)	Ideberg V fracture (left side)	Fall	Commotio cerebri	3	Osteosynthesis with plates	Dorsal	Yes
3; m (34 years)	Facture of the anatomical neck and the body of the scapula (right side)	Car accident	Serial rib fracture (right)	10	Osteosynthesis with plates	Dorsal	Yes
4; m (42 years)	Fracture of the surgical neck of the scapula (left side)	Pedestrain against car	Polytrauma	1	Osteosynthesis with screws	Dorsal	Yes
5; m (47 years)	Ideberg V fracture (left side)	Bicycle	None	4	Osteosynthesis with plates	Dorsal	Yes
6; m (38 years)	Fracture of the surgical neck of the scapula and the clavicle (left side)	Car accident	Polytrauma	2	Osteosynthesis with plates and screws	Dorsal	No
7; m (35 years)	Fracture of the surgical neck of the scapula	Car accident	Polytrauma	12	Osteosynthesis with plates	Dorsal	No
8; m (40 years)	Ideberg III fracture (left side)	Kicked by a horse	Commotio cerebri	2	Osteosynthesis with screws	Ventral	Yes
9; m (17 years)	Fracture of the coracoid process + acromioclavicular dislocation (right side)	Bicycle	None	1	Osteosynthesis with screws	Ventral	Yes
10; m (21 years)	Fracture of the coracoid process (right side)	Motorcycle accident	None	5	Osteosynthesis with screws	Ventral	Yes
11; f (23 years)	Fracture of the acromion and the clavicle + acromioclavicular dislocation (left side)	Kicked by a horse	Craniocerebral trauma	0	Osteosynthesis with K-wires	Ventral	Yes
12; m (34 years)	Fracture of the surgical neck and the spine of the scapula + fracture of the clavicle (right side)	Motorcycle accident	Fracture of the metacarpal bones on the right	2	Osteosynthesis with plates	Dorsal	Yes
13; m (29 years)	Fracture of the surgical neck and the spine of the scapula + fracture of the clavicle (left side)	A tree fell on his shoulder	Polytrauma	0	Osteosynthesis with plates	Dorsal	Yes
14; m (48 years)	Fracture of the acromion and coracoid process + acromio-clavicular dislocation (right side)	Fall	Craniocerebral trauma	10	Osteosynthesis with K-wires	From above	Yes
15; m (47 years)	Fracture of the anatomical neck of the scapula + acromio-clavicular dislocation (right side)	Fall of a horse	None	2	Osteosynthesis with screws and K-wires	Ventral	Yes
16; m (22 years)	Ideberg II fracture (left side)	Bicycle	None	4	Osteosynthesis with screws	Ventral	No
17; m (48 years)	Fracture of the surgical neck of the scapula and fracture of the clavicle (left side)	Bicycle	Serial rib fractures (left)	5	Osteosynthesis with plates	Dorsal	Yes
18; m (48 years)	Fracture of the acromion (right side)	Motocyle accident	Commotio cerebri	3	Osteosynthesis with screws	Ventral	No
19; m (25 years)	Fracture of the surgical neck of the scapula (right side)	Car accident	None	6	Osteosynthesis with screws	Dorsal	Yes
20; m (16 years)	Fracture of the coracoid process (right side)	Bicycle	None	3	Osteosynthesis with screws	Ventral	Yes
21; m (44 years)	Ideberg I fracture (left side)	A pallet fell on his shoulder	Fracture of the ankle joint	3	Osteosynthesis with screws	Ventral	Yes
22; f (46 years)	Fracture of the coracoid process (right side)	Pedestrian against car	Craniocerebral trauma + fracture of the head of the right humerus	0	Osteosynthesis with screws	Ventral	Yes
23; f (39 years)	Ideberg I fracture (right side)	Ski accident	None	5	Osteosynthesis with screws	Ventral	Yes
24; f (28 years)	Fracture of the coracoid process (left side)	Car accident	Craniocerebral trauma	12	Osteosynthesis with plates	Ventral	Yes
25; m (30 years)	Fracture of the surgical neck and of the spine of the scapula (right side)	Pedestrian against car	Fracture of both crura	1	Osteosynthesis with plates	Dorsal	No

Table 2 Distribution of the fractures

	$n = 25$	$n = 20$
Fractures of the body and the processes		
Body	1[a]	1[a]
Spine of the scapula	0	0
Acromial process	2 + 1[a]	1 + 1[a]
Coracoid process	5 + 1[a]	5 + 1[a]
Fractures of the neck		
Anatomical neck	1 + 1[a]	1 + 1[a]
Surgical neck	3	2
Surgical neck + clavicle and/or spine of the scapula	5	3
Fractures of the glenoid		
Ideberg type I	3	3
Ideberg type II	1	0
Ideberg type III	1	1
Ideberg type IV	0	0
Ideberg type V	2	2
Ideberg type VI	0	0

[a] Both cases were marked fractures

Surgery was performed on average 4.1 days (range 0–12 days) after the accident. There were no early complications (infection, hematoma, nerve damage, disturbances in wound healing). In one patients a breakage of K-wires occurred 3 months after the operation.

The function of the shoulder was classified in keeping with the Constant score [2]. A perfect result consisted of 100 points, calculated from pain (0–15 points), daily activities (0–20 points), range of motion (0-40 points) and strength (0–25 points). In addition to the questionnaire, the follow-up included roentgenograms in two planes (AP, Y-view) and, for glenoid fractures, a computed tomography (CT) scan.

Results

Twelve out of 20 patients (60%) were free of pain, 7 (35%) had minimal pain.

Fifteen patients (75%) had no constraint and 3 patients (15%) almost no constraint in their working ability. Leisure time activity was not hampered in 13 patients (65%) and only a little reduced in 4 patients (20%). In 85% (17 patients) the hand could be elevated above the head, in 10% (2 patients) to the forehead. Some 85% (17 patients) remarked that they enjoyed undisturbed sleep.

The range of motion of the shoulder joint was unrestricted in more than half of the patients (12 patients), while 3 showed a minor limitation.

In isokinetic strength measurement, 55% of patients (11 patients) attained a maximum of 25 points, and 30% (6 patients) as much as 20 points.

The evaluation of the Constant score showed an overall result that was very good in 65%, good in 10%, fair in 20% and poor in 5%. The poor result involved a patient with a well-healed scapular fracture (Ideberg I) but with a disabling concomitant rupture of the rotatory cuff.

Tables 2 and 3 show the distribution of points and the total results for each patients, respectively.

In one case there was a mild and in another a marked post-traumatic arthrosis with incongruency of the glenoid surface (Table 4).

Table 3 Point scores of the patients

Patient number	Pain (max. 15 points)	Daily activities (max. 20 points)	Motility (max. 40 points)	Strength (max. 25 points)	Total (max. 100 points)	Valuation of the result
1	10	18	22	10	60	Fair
2	15	20	38	25	98	Excellent
3	10	16	30	0	56	Fair
4	15	20	36	20	91	Excellent
5	15	20	38	25	98	Excellent
8	10	17	34	20	81	Good
9	15	20	38	25	98	Excellent
10	15	20	38	25	98	Excellent
11	15	20	40	25	100	Excellent
12	15	20	38	25	98	Excellent
13	15	19	34	20	88	Good
14	10	14	18	15	57	Fair
15	15	20	40	25	100	Excellent
17	15	20	38	20	93	Excellent
19	15	20	38	25	98	Excellent
20	15	20	40	25	100	Excellent
21	0	6	6	0	12	Poor
22	10	19	24	20	73	Fair
23	10	18	38	25	91	Excellent
24	10	19	38	25	92	Excellent
Average	12.5	18.3	33.3	20	84.1	Good

Total result (Constant score)

Points	Patients (n)	Result (valuation)
100–91	13	Excellent
90–75	2	Good
75–51	4	Fair
≤ 50	1	Poor

Table 4 Radiological results of the fractures of the glenoid

Patient number	Arthrosis (none, slight, moderate, poor)	Steps in the glenoid
1	None	None
2	Moderate	≤ 2 mm
5	None	None
8	Poor	> 2 mm
21	None	None
23	None	None

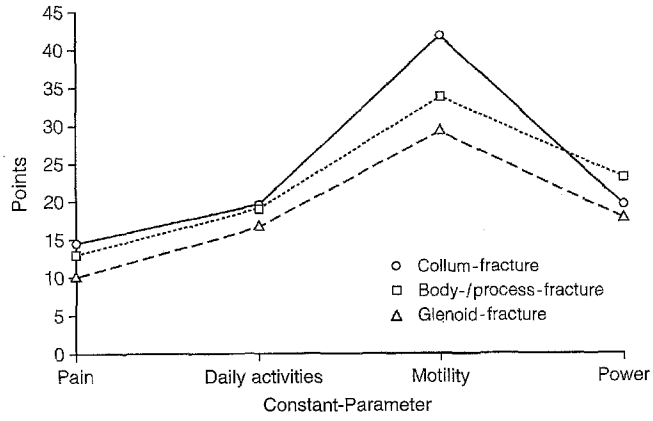
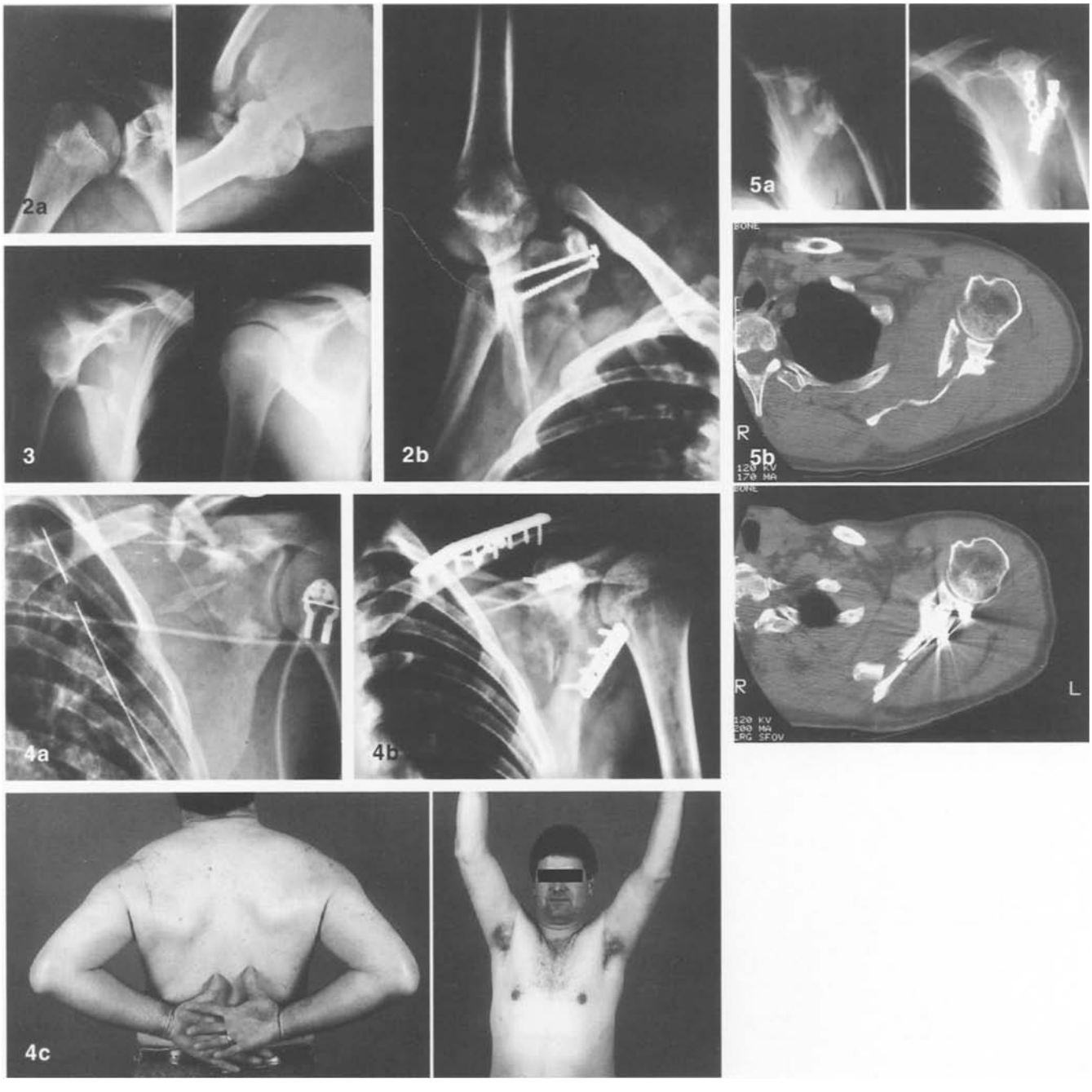


Fig. 1 Results according to fracture type



Comparison of fracture types showed a prevalence of reduced results (especially range of motion) with glenoid fractures, while fractures of the neck had the best long-term results (Fig. 1).

Discussion

The high number of severe injuries accompanying scapular fractures (up to 92%) is adequately documented in the literature, and it is generally accepted that fracture treatment of the scapula is of minor importance in the severely injured patient [1, 8, 13]. Nevertheless, this fact should not be used as a justification for inadequate therapy [8]. A judicious concept considering the benefits of conservative and operative treatment for each patient and each fracture type is essential to achieve good results. Better understanding of polytrauma-induced pathophysiology with a favourable impact on therapy and patient outcome enables us to operate on most patients within the first 2 weeks following the accident.

A literature search shows that most publications focus on the mechanism of trauma and concomitant injuries, whereas little or no attention is paid to the results of conservative or operative treatment with regard to specific fracture types [1, 8, 9, 11]. Therefore, there is not too much significance in the finding of a 73% incidence of very good and good results with conservative treatment of scapular fractures in general [9].

In 1984 Hardegger [4] emphasized the therapeutic and prognostic difference of two groups of scapular fractures. The first group consisted on non- or minimally displaced fractures of the body, neck and apophyses and comprised more than 90% of all scapular fractures. Conservative treatment usually brings about good results [13]. The second group included displaced fractures of the glenoid, unstable fractures of the neck and major dislocations in apophyseal fractures. The patient outcome with open reduction and internal fixation is better than with conservative treatment [3, 4, 5, 7, 12–14].

Ideberg's classification [5] of glenoid fractures has gained international acceptance. In 1990, Ruedi et al. [10] presented an enlarged classification comprising all types of scapular fractures. Its therapeutic implications facilitate the comparability of results.

Depending on age, activity, and general condition of the patient, ORIF is recommended in: grossly displaced fractures of the acromion and coracoid process (Fig. 2); displaced fractures of the anatomical neck (Fig. 3); unstable fractures of the surgical neck (Fig. 4); displaced fractures of the glenoid (Fig. 5).

Often, CT scanning has to be combined with conventional radiography to define the exact type of the fracture. On the basis of our experience, we recommended early operative treatment for the type of fractures enumerated above in order to achieve good results.

◀ **Fig. 2 a** Case 9. A 17 year-old male patient sustained a dislocated fracture of the coracoid process in a bicycle accident. **b** At the 2-year follow-up examination, axillary radiography demonstrated consolidation of the fracture. Internal fixation had been performed with two screws

Fig. 3 Case 3. *Left side* Anteroposterior radiograph shows the dislocated fracture of the anatomical neck. *Right side* Anteroposterior radiograph 6 months after internal fixation with plate. The neck fracture has healed

Fig. 4 a Case 13. Anteroposterior radiograph shows a burst fracture of the surgical neck, a fracture of the spine and a fracture of the clavicle **b** Three months after internal fixation with plates. **c** Excellent functional recovery 10 years after the accident

Fig. 5 a Case 5. *Left side* Anteroposterior radiograph shows a fracture of the glenoid fossa (Ideberg V fracture). *Right side* Postoperative radiograph demonstrating internal fixation with two plates **b** *Left side* A vertical fracture line with major displacement was confirmed on a computed tomography (CT) scan. *Right side* Postoperative CT scan demonstrated the fracture of the glenoid fossa without incongruity of the joint

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