

Patient related functional outcome of glenoid rim fractures treated with open reduction and internal fixation

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The aim of this study was to evaluate patient related outcome and shoulder stability following open reduction and internal fixation (ORIF) in patients with glenoid rim fractures. After a median follow-up of four years, 14 patients completed the Rowe Shoulder Stability Score and Quick DASH questionnaire. The median Rowe score was 90 (Q₁ : 88, Q₃ : 100). Results were graded excellent in 11 patients and good in three. The median DASH score was 4.6 (Q₁ : 0, Q₃ : 32). In conclusion this study showed that ORIF of type 1a and 2 glenoid rim fractures provided satisfactory results with respect to prevention of instability. However, patient reported functional outcome was disappointing in 21% of the patients.

Keywords : shoulder dislocation ; glenoid rim fracture ; ORIF ; functional outcome.

Glenoid rim fractures are reportedly frequently missed, and this may result in chronic shoulder instability, persistent pain, malunion and early onset of osteoarthritis (4,10,15). DePalma stated that instability can be anticipated if the fracture is displaced 10 mm or more and if at least one fourth of the anterior aspect of the glenoid cavity or one third of the posterior aspect of the glenoid cavity is involved (5). Rockwood advises open reduction and internal fixation (ORIF) when one fourth of the glenoid fossa is involved in association with shoulder instability. Goss describes surgical management if the glenoid rim fracture results in persistent subluxation of the humeral head (6).

INTRODUCTION

In 1923 Bankart was first to report on recurrent shoulder dislocations. In this classic study, however, no fractures of the glenoid rim but only tears in the fibro-cartilaginous glenoid labrum were described (2). Nearly sixty years later Rowe described a combination of a glenoid rim fracture and avulsion of the gleno-humeral labral complex (18). In contrast to Bankart, Rowe and other authors described this condition in high-energy shoulder dislocations as well as in low-energy dislocations (1,18).

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In order to prevent chronic instability, ORIF of glenoid rim fractures has gained more popularity in recent years. There have been many reports on open reduction and internal fixation in the acute phase for glenoid rim fractures, with different results (9,13,14,16,20).

The aim of this study was to evaluate patient related outcome and shoulder stability following ORIF in patients with glenoid rim fractures.

PATIENTS AND METHODS

We performed a retrospective cohort study of all consecutive patients with a glenoid rim fracture who were treated with ORIF between 2000 and 2008 in our institution. Inclusion criteria were : age above 18 years and an Ideberg type 1a or 2 glenoid fracture.

The glenoid rim fractures were classified according to the Ideberg classification, as modified by Goss, on the plain radiographs (6,8). This classification is defined as follows : type 1a ; anterior rim fracture, type 2 ; fracture of the glenoid fossa exiting at the lateral border of the scapula. Although this classification is designed for plain radiographs only, all fractures were additionally classified on preoperative 2D CT scans in the same way. Fracture classification was performed by a radiologist and a trauma surgeon.

The indication for operation in our institution was defined as follows : all type 1a and 2 fractures with at least one fourth of the anterior aspect of the glenoid cavity involved and a displacement of the fracture fragment of more than 4 mm underwent ORIF.

Patient related functional outcome was evaluated with the short version Disabilities of the Arm, Shoulder Hand (Quick-DASH) questionnaire. Postoperative shoulder stability was assessed using the Rowe Shoulder Stability Score.

The Rowe Shoulder Stability Score contains three domains : stability, range of movement and function. Each is accorded one of four possible values. With regard to stability 'no recurrence, subluxation or apprehension' has the maximum score (50 points) while 'recurrent dislocation' receives the minimum score (0). Assessment of movement gives the maximum score (20 points) for '100% of normal external and internal rotation and elevation', and the lowest score (0) for '50% of normal elevation and internal elevation but no external rotation'. Function is graded as a maximum score of 30 points for 'no limitation in work or sports and little or

no discomfort' with the lowest score (0) going to 'marked limitation and pain.' The totals for each are added to produce an overall range of scores between 0 and 100. A score of 90 to 100 is judged 'excellent', 75 to 89 as 'good', 51 to 74 'fair' and 50 or less 'poor' (17,18).

The Quick-DASH score is a validated 11-item, self report questionnaire designed to measure physical function and symptoms in patients with musculoskeletal disorders of the upper limb. The scores range from 0 (no disability) to 100 (most severe disability) (3,7).

Statistics

Statistical analyses were performed with SPSS for Windows (release 17.0, SPSS Inc, Chicago, Illinois, USA). Continuous variables were expressed as the median and interquartile range (IQR) because of the small sample size. Categorical variables are expressed as frequency (percentage).

Operative technique

A standard delto-pectoral approach was used. The inferior part of the subscapularis muscle was incised vertically along with the capsule of the gleno-humeral joint, approximately one cm from its humeral insertion. Care was taken not to damage the anterior humeral circumflex artery.

With the help of a 1.25 mm threaded K-wire acting as a joy-stick, the fragment was reduced. Subsequently, a second threaded K-wire was drilled to fix the fragment to the glenoid. The quality of the reduction was checked with inspection and with the image intensifier. If the surgeon was satisfied a third K-wire was drilled to guide a threaded 3.5 mm cannulated screw (Synthes, Zeist, The Netherlands), washers were used at the discretion of the surgeon (fig 1). Under fluoroscopy, while moving the arm, screw position was checked and the K-wires were removed. Additional labrum lesions were addressed with suture anchors (DePuy, Mitek GII™). The capsule and subscapularis muscle were reattached with absorbable sutures.

Postoperatively the affected limb was placed in a Tricodur® Gilchrist (BSN Medical) shoulder immobilizer for one week. After the first week the patient started with pendulum exercises. During the first six weeks post-operatively abduction was restricted to 90° and lifting heavy loads with the operated arm was prohibited. After this period abduction and muscle strength were enhanced to regain full range of motion. Physiotherapy was initiated shortly after the first week.



Fig 1. — Example of correct reduction and screw fixation



Fig 2. — Post operative radiograph showing significant erosion of the humeral head due to malposition of the screws.

RESULTS

Between 2000 and 2008, 25 patients were surgically treated for glenoid fractures at our institution. Three patients had an Ideberg type 3 lesion and two patients were dead at the time this study started; these 5 patients were excluded. The 20 remaining patients were included in the study: 14 men and 6 women with a median age of 53 years (Q_1 : 46, Q_3 : 61). All patients sustained their injury in sports activities or a high-energy trauma. Sixteen of these 20 patients (80%) presented with an anterior shoulder dislocation in our Emergency Department. Fourteen out of these 20 patients filled out the questionnaires (response rate 70%).

In all of these 14 patients a CT scan was made preoperatively. In most of these 14 patients additional lesions were diagnosed (table I).

The median time interval from trauma to surgery was 13 days (Q_1 : 9, Q_3 : 19). Median follow-up was 3.8 years (Q_1 : 1, Q_3 : 6). All fractures healed. No re-dislocations following surgery were observed. The median Rowe score was 90 (Q_1 : 88, Q_3 : 100). Results were graded excellent in 11 patients and

good in three. The median DASH score was 4.6 (Q_1 : 0, Q_3 : 32).

In two patients there was malposition of the screws which led to erosion of the humeral head (fig 2). In both patients the screws were removed early. In one of these patients a loose body was removed arthroscopically four years later.

DISCUSSION

There are a few studies that report on patient related outcome using validated questionnaires following ORIF of anterior glenoid rim lesions (14,16,19,20). All these series report small numbers of patients (15-29) and in most series a combination of acute injuries and chronic glenoid erosions is described. Raiss *et al* found a mean DASH score of 10 points after a follow up of 6.5 years in their patient group (16). Scheibel *et al* (20) and Osti *et al* (14) found a mean Rowe score of 94 and 90 respectively in their patients.

This patient series only included acute glenoid rim fractures. Patient related outcome showed that patients did not experience residual instability, with

Table I. — Patient demographics. DASH scores are rounded to whole numbers.
MVA : Motor Vehicle Accident. ED : Emergency Department.

N :	Sex/age	Type	Side	Dislocation at ED	Mechanism	Associated injuries	Rowe score	DASH score
1	F, 65	1B	R	yes	Fall	Hill Sachs	75	40
2	M, 54	1B	R	yes	Fall	Hill Sachs	100	0
3	M, 46	2	R	yes	Fall	Hill Sachs+SLAP lesion	80	29
4	F, 48	1B	L	yes	Fall	Hill Sachs+ labrum tear	90	41
5	F, 60	1B	L	Yes	Fall	Labrum tear	100	0
6	M, 53	2	R	No	MVA	Scapula fracture	75	29
7	M, 52	1B	L	yes	MVA	Fracture proximal humerus	90	2
8	F, 70	1B	R	no	Fall		100	0
9	F, 62	1B	R	yes	Fall		90	43
10	M, 55	1B	R	yes	Fall	Tub. Maj. fracture	100	0
11	M, 42	1B	L	yes	Fall	Tub. Maj. fracture	90	7
12	M, 35	1B	R	yes	Fall	Hill Sachs + proc coracoideus fracture	100	0
13	M, 49	1B	R	no	Fall	Labrum tear	100	0
14	M, 46	1B	L	yes	Fall		90	14

a median Rowe score of 90, and had an excellent functional outcome with a median QDASH score of approximately five points. These results correspond with those of Scheibel *et al* (20) and Osti *et al* (14).

However, the 75th percentile of the QDash score is 32, meaning that 25% of our patients had an outcome of 32 points or higher. Three patients (21%) had a QDASH score of 40 or higher. In these patients the Rowe score ranged between 75 and 90 indicating a good outcome. The QDASH and the Rowe score do not seem to correlate much in these patients.

Until now the QDASH score has not been categorized, therefore interpreting a QDASH score may be difficult. However, MacDermid *et al* described patient's DASH score of 44 is consistent with a person reporting substantial disability due to rotator cuff pathology (11). We think it is reasonable to extrapolate this finding to a patient with ORIF of a glenoid rim fracture and therefore conclude that three patients still suffer from substantial disability. Moreover, in two patients the screw tips entered the glenohumeral joint and had to be removed afterward. One of these patients had a QDASH score of

29, the other patient did not respond. Scheibel *et al* also reported complications secondary to screw impingement (20). It is recommended to place the screws 3 mm medial to the glenoid rim. This will probably minimize complications in combination with the use of smaller implants (21).

Maquieira *et al* reported on the conservative treatment of large fragments. In their series of 14 patients, they showed that, if the gleno-humeral joint is concentrically reduced and if the capsular ligament complex is intact, the functional outcome scores (Constant score) were excellent. There were no re-dislocations and no subluxation reported in their series. The average age of their patients was around 50 years of age, as in our series. Patients had a mean fragment size of 17 mm and the mean displacement of the fragment was 8 mm (12). Bearing these results in mind one can debate about the need for ORIF of these kinds of fractures.

Limitations of our study include its retrospective design and the relatively small number of patients. Moreover, selection bias due to indication cannot be excluded because the surgeon decided which patients were operated.

In conclusion this study shows that ORIF of type 1a and 2 glenoid rim fractures was successful in preventing instability. However, patient reported functional outcome was disappointing in 21% of the patients. Moreover, the chance of screw misplacement was substantial. Future studies should report Rowe and Dash scores in combinations with standard deviations or interquartile range to facilitate inclusion in future meta-analyses.

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REFERENCES

1. **Aston JW Jr, Gregory CF.** Dislocation of the shoulder with significant fracture of the glenoid. *J Bone Joint Surg* 1973 ; 55-A : 1531-1533.
2. **Bankart AS.** Recurrent or habitual dislocation of the shoulder joint. *Br Med J* 1923 ; 3285 : 1132-1133.
3. **Beaton DE, Wright JG, Katz JN.** Development of the QuickDASH : comparison of three item-reduction approaches. *J Bone Joint Surg* 2005 ; 87-A : 1038-1046.
4. **Bigliani LU, Newton PM, Steinmann SP, Connor PM, McIlveen SJ.** Glenoid rim lesions associated with recurrent anterior dislocation of the shoulder. *Am J Sports Med* 1998 ; 26 : 41-45.
5. **DePalma AF.** *Surgery of the Shoulder* Lippincott, 1983, 3rd edition, pp 366-367.
6. **Goss TP.** Fractures of the glenoid cavity. *J Bone Joint Surg* 1992 ; 74-A : 299-305.
7. **Gummeson C, Ward MM, Atroshi I.** The shortened disabilities of the arm, shoulder and hand questionnaire (QuickDASH) : validity and reliability based on responses within the full-length DASH. *BMC Musculoskelet Disord* 2006 ; 7 : 44.
8. **Ideberg R, Grevsten S, Larsson S.** Epidemiology of scapular fractures. Incidence and classification of 338 fractures. *Acta Orthop Scand* 1995 ; 66 : 395-397.
9. **Kavanagh BF, Bradway JK, Cofield RH.** Open reduction and internal fixation of displaced intra-articular fractures of the glenoid fossa. *J Bone Joint Surg* 1993 ; 75-A : 479-484.
10. **Kummel BM.** Fractures of the glenoid causing chronic dislocation of the shoulder. *Clin Orthop Relat Res* 1970 ; 69 : 189-191.
11. **MacDermid JC, Stratford P.** Applying evidence on outcome measures to hand therapy practice. *J Hand Ther* 2004 ; 17 : 165-173.
12. **Maquieira GJ, Espinosa N, Gerber C, Eid K.** Non-operative treatment of large anterior glenoid rim fractures after traumatic anterior dislocation of the shoulder. *J Bone Joint Surg* 2007 ; 89-B : 1347-1351.
13. **Mayo KA, Benirschke SK, Mast JW.** Displaced fractures of the glenoid fossa. Results of open reduction and internal fixation. *Clin Orthop Relat Res* 1998 ; 347 : 122-130.
14. **Osti M, Gohm A, Benedetto KP.** Results of open reconstruction of anterior glenoid rim fractures following shoulder dislocation. *Arch Orthop Trauma Surg* 2009 ; 129 : 1245-1249.
15. **Porcellini G, Campi F, Paladini P.** Arthroscopic approach to acute bony Bankart lesion. *Arthroscopy* 2002 ; 18 : 764-769.
16. **Raiss P, Baumann F, Akbar M, Rickert M, Loew M.** Open screw fixation of large anterior glenoid rim fractures : mid- and long-term results in 29 patients. *Knee Surg Sports Traumatol Arthrosc* 2009 ; 17 : 195-203.
17. **Rowe CR, Patel D, Southmayd WW.** The Bankart procedure : a long-term end-result study. *J Bone Joint Surg* 1978 ; 60-A : 1-16.
18. **Rowe CR, Zarins B.** Recurrent transient subluxation of the shoulder. *J Bone Joint Surg* 1981 ; 63-A : 863-872.
19. **Schandelmaier P, Blauth M, Schneider C, Krettek C.** Fractures of the glenoid treated by operation. A 5- to 23-year follow-up of 22 cases. *J Bone Joint Surg* 2002 ; 84-B : 173-177.
20. **Scheibel M, Magosch P, Lichtenberg S, Habermeyer P.** Open reconstruction of anterior glenoid rim fractures. *Knee Surg Sports Traumatol Arthrosc* 2004 ; 12 : 568-573.
21. **Tauber M, Moursy M, Eppel M, Koller H, Resch H.** Arthroscopic screw fixation of large anterior glenoid fractures. *Knee Surg Sports Traumatol Arthrosc* 2008 ; 16 : 326-332.