Non-operative treatment of large anterior glenoid rim fractures after traumatic anterior dislocation of the shoulder

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The generally-accepted treatment for large, displaced fractures of the glenoid associated with traumatic anterior dislocation of the shoulder is operative repair. In this study, 14 consecutive patients with large (> 5 mm), displaced (> 2 mm) anteroinferior glenoid rim fractures were treated non-operatively if post-reduction radiographs showed a centred glenohumeral joint.

After a mean follow-up of 5.6 years (2.8 to 8.4), the mean Constant score and subjective shoulder value were 98% (90% to 100%) and 97% (90% to 100%), respectively. There were no redislocations or subluxations, and the apprehension test was negative. All fragments healed with an average intra-articular step of 3.0 mm (0.5 to 11). No patient had symptoms of osteoarthritis, which was mild in two shoulders and moderate in one.

Traumatic anterior dislocation of the shoulder, associated with a large displaced glenoid rim fracture can be successfully treated non-operatively, providing the glenohumeral joint is concentrically reduced on the anteroposterior radiograph.

Fracture of the glenoid rim frequently occurs in association with primary traumatic anterior dislocation of the shoulder, with a reported incidence of between 5% and 30%.1,2 The optimal treatment is controversial, but operative repair is usually preferred to prevent recurrent instability.5,6 However, it is unclear whether an acute glenoid rim fracture affects stability sufficiently to warrant surgical repair.5,7 The size of fragment that might predispose to recurrent instability is unknown. Most reports focus on small, so-called chip fractures,8 and large fragments are rare.9 The most accepted current treatment for chip fractures is non-operative and for larger, displaced fractures is open reduction and fixation.4,10,11

We have observed that shoulders with large, displaced anterior glenoid rim fractures can do well without operation. In order to confirm this hypothesis, we studied a group of consecutive patients who had a large, displaced anterior glenoid rim fracture associated with anterior dislocation of the shoulder.

Patients and Methods

Between 1996 and 2004, 26 patients with traumatic anteroinferior glenoid rim fractures were treated at the Department of Orthopaedics, University of Zurich, and the Division of Trauma Surgery, University Hospital of Zurich. All had sustained their fractures during a first-time anterior dislocation. The minimal size of the glenoid fragment on conventional radiographs was defined as more than 5 mm, corresponding to an Ileberg type 1B fracture,12 and the humeral head had to be concentrically reduced on the anteroposterior (AP) radiograph (Fig. 1). Eight shoulders with previous instability, loss of concentricity on post-reduction radiographs, or shoulders with concomitant injuries requiring operation, were excluded. One patient who refused to use a sling or other form of protection repeatedly externally rotated, abducted the affected arm and sustained two further dislocations. He was treated surgically and excluded from the study. Two patients refused to participate despite good clinical results. Another sustained a traumatic, massive rotator cuff tear five years after the glenoid rim fracture, without any symptoms of instability in the interim. He underwent appropriate surgery and was excluded from the study. After these exclusions, there were 11 men and three women remaining, with a mean age of 53 years (32 to 73) at the time of injury. In eight cases the dominant, and in six the non-dominant shoulder was injured. The left shoulder was affected in nine patients and the right in five. Seven injuries occurred during skiing, one playing football, one while cycling, and five during other falls. A disloca-
tion of the shoulder with reduction was documented in nine patients and two reported a sensation of dislocation with spontaneous reduction. Three described a painful injury with neither subjective dislocation nor manipulative reduction, but a Hill-Sachs lesion was radiologically documented in all, thus indicating a significant dislocation of the glenohumeral joint. Additional non-displaced greater tuberosity fractures were seen in five patients, of whom one had a further fracture of the lesser tuberosity.

Non-operative treatment consisted of pendulum exercises from the first day after reduction, with elevation in internal rotation restricted to 90° and external rotation to 0° for six weeks. Physiotherapy and a sling were recommended for two weeks, and after six weeks, free active and passive motion was permitted with a return to sport after three months. Radiological assessment at injury included classification of the glenoid rim fracture according to Ideberg et al., estimation of its size and displacement, glenohumeral degenerative changes, and subluxation of the humeral head with respect to the glenoid. Measurement of the size and displacement of the fracture was performed on AP radiographs in all 14 patients and also, if available, on CT (eight patients) or MR (one patient) scans immediately after reduction.

At the final follow-up, clinical evaluation included an assessment of subjective instability, worker’s compensation status, complications, and a standard physical examination of stability (anterior apprehension test, sulcus sign in external rotation, and hyperabduction test), assessment of the subjective shoulder value, an age- and gender-matched Constant and Murley score, an AP radiograph in neutral rotation, an axial view radiograph and CT.

The position of the humeral head in relation to the glenoid was estimated on CT according to Walch (Fig. 2). The joint was considered to be centred if the index was between 40% and 60%.

Osteoarthritis (OA) was assessed on conventional AP radiographs according to Samilson and Prieto. This classification was slightly modified as previously described. Osteoarthritis was defined as stage 1 when an osteophyte of the humeral head measured less than 3 mm. Osteophytes ranging between 3 mm and 5 mm defined stage 2, and those more than 5 mm, stage 3.

Results
At a mean follow-up of 5.6 years (2.8 to 8.4), all 14 patients reported a stable shoulder and rated their outcome as excellent. There were no complications, no redislocations, and no further intervention was necessary or planned. All were unrestricted in their professional and leisure activities, and none was receiving worker’s compensation.

The mean age- and gender-matched Constant and Murley Score was 98% (90% to 100%), and the mean subjective shoulder value was 97% (90% to 100%). All patients were free from pain, with a normal range of movement. Two patients with concomitant fractures of the greater tuberosity had loss of external rotation of 10° and 20° respectively. In another patient, abduction strength was decreased by more
than 10% compared with the contralateral side. The anterior apprehension test and sulcus sign were negative in all patients, the hyperabduction test showed an increase of 5˚ to 10˚ of the affected shoulder in seven of 14 patients, but none was pathological.

On standard post-reduction radiographs the mean fragment length was 17 mm (12 to 22) and the width was 8 mm (4 to 14). In ten patients (nine CT and one MRI), three-dimensional measurement was possible. The mean height was 17 mm (12 to 24), length 12 mm (7 to 17), and width 10 mm (7 to 15). Measurements of fragment size and displacement by conventional radiographs and CT correlated well in nine patients for whom both were available (correlation coefficient \( r = 0.784, r = 0.746 \), respectively). Therefore, estimations by conventional radiographs were considered to be accurate for the other five patients. The mean displacement of the fragment was 8 mm (2 to 20). In seven patients, a second fragment was detected on conventional radiographs (Fig. 3a), with a mean height of 9 mm (6 to 16), length of 12 mm (4 to 20) and width of 6 mm (2 to 10).

At final follow-up, the main anteroinferior glenoid fragment was consolidated to the scapular neck in all shoulders. A total of 14 CT scans showed a mean step-off of 3.0 mm (0.5 to 11.0; Fig. 3b). A second fragment was found in eight patients. In four of these, the fragments were loose bodies within the subcapular recess (Fig. 3c); in two the fragment was free next to the posterior glenoid rim, and in one beside the anterior glenoid rim. The second fragment was consolidated to the scapula in only one of these eight shoulders.

At the time of injury there was a minor osteophyte smaller than 3 mm on two humeral heads, correlating with stage 1 OA. In the remaining 12 shoulders there were no radiological signs of OA.

At follow-up, the degree of OA on AP radiographs increased from stage 0 to 1 in two patients and from stage 0 to 2 in one. The mean age of these three patients was 74 years (69 to 80). Although CT scans confirmed mild or moderate OA in these three patients, none was symptomatic. Severe OA was not found. The two patients with stage 1 OA at injury were unchanged at final follow-up.

Of the 14 shoulders, 13 were centred on CT (index range 40% to 60%) at final follow-up. One was subluxed anteriorly (index 37%) but the patient was asymptomatic.

After reduction, all nine shoulders with CT or MR scans were classified as centred (index range 40% to 60%). Four showed an index between 45% and 55%, three between 40% and 44%, and two between 56% and 60%.

**Discussion**

This study shows that non-operative treatment of large anteroinferior glenoid rim fractures sustained during an episode of traumatic anterior shoulder instability leads to a stable, functional shoulder and high patient satisfaction. Moreover, at least within the first five years after injury, the development of OA is not a clinical problem. The three shoulders with mild to moderate radiological OA had a tendency toward anterior subluxation with a centering index between 37% and 45%, but they were asymptomatic.

The size and displacement of the glenoid fragment are thought to be important when advising treatment.\(^{10,11}\) Geel\(^{10}\) recommended open reduction and stabilisation of a large glenoid rim fragment, if displacement is more than 3 mm. De Palma\(^4\) stated that a fragment displaced more than 10 mm and corresponding to one-quarter of the glenoid surface should be treated by open reduction and internal fixation. Itoi et al\(^5\) concluded from osteotomised cadaver glenoids that a bony defect of more than 20% might cause glenohumeral instability. Gerber and Nyffeler\(^19\) showed that the size of the fragment becomes relevant if the fracture length is more than half the greatest diameter of the glenoid.

Clinical results of non-operative treatment after glenoid rim fractures have mostly been presented in cases where the diagnosis was initially missed. In 68 patients with type I lesions\(^{12}\) and acute shoulder dislocation, Ideberg\(^{20}\) described 11 with a very small glenoid rim fragment a so called ‘chip fracture’, who had to be treated operatively because of subluxation, unstable reduction or fragment fixation alone. The remaining 57 patients were treated non-operatively and had an uneventful recovery. He concluded that the size of the fragment in type I fractures is not such as to cause later instability.

The results of open reduction and internal fixation of acute glenoid rim fractures are rarely reported and are difficult to interpret, as the studies often include different types of fracture or lack distinction between acute injuries and chronic glenoid erosions.\(^3,21\) Such erosions in recurrent...
instability\textsuperscript{22} must be clearly distinguished from acute
glenoid rim fractures.

More recently, arthroscopic procedures have been advo-
cated for fracture fixation.\textsuperscript{23-25} However, authors favouring
open or arthroscopic approaches do not consider the alter-
native of conservative management and describe variable
but significant impairment of function. Porcellini et al\textsuperscript{24}
reported a mean loss of external rotation of 10˚ after
arthroscopic fixation of glenoid rim fractures, whereas in
our study patients regained symmetrical external rotation
and excellent function. Also, various complications, albeit
rare, such as nerve palsy, chronic pain, infection, or the
early onset of OA because of screw impingement, are
reported after operative treatment.\textsuperscript{3,26,27}

Itoi et al\textsuperscript{28} recommended immobilisation of the shoulder
in 10˚ of external rotation for three weeks after gleno-
humeral dislocation. These findings were not published
when our study was begun, and the mechanisms of capsular
avulsion and glenoid rim fracture may not be comparable.
Itoi’s concept is to allow healing of the detached capsule to
the scapular neck. In our study, there was no need for soft
tissues to heal to the scapular neck and bony healing was
obtained in all cases.

To our knowledge, no study has evaluated the potential
to reduce a displaced glenoid rim fragment by external
rotation of the shoulder. However, our results suggest that
it is unnecessary to advise an external rotation brace and
risk poor compliance because of this cumbersome position.

Various factors may be responsible for our excellent
results despite previous concerns. Because the gleno-
humeral joint is less weight-bearing than the hip, the intra-
articular step may not lead to degenerative changes. The
relatively high age of our patients reflects the age at which
this type of injury occurs and its low recurrence rate may
relate to the different types of injury compared with those
seen in younger patients. We propose that large fragments
remain in continuity with the ligament complex. This
allows consolidation of the fragment and restoration of
stability and contrasts with dislocations associated with
very small fragments, where the capsular ligament complex
may be disrupted, leading to nonunion and/or recurrent
instability as seen in younger patients.\textsuperscript{19}

In conclusion, traumatic anterior shoulder dislocation
with a large, displaced glenoid rim fracture can be success-
fully treated non-operatively, provided the glenohumeral
joint is concentrically reduced.

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Fig. 3a

a) Anteroposterior post-reduction radiograph of a right shoulder in a 58-year-old man. A second fragment (arrow) could be misdiagnosed as an ossi-
fication of the subscapular recess. b) A CT scan of the same patient. The glenoid fragment (arrow) is consolidated to the anteroinferior scapular wall and
c) the second fracture fragment (arrow) is identified in the subscapular recess.


