ROTATION OSTEOTOMY OF THE PROXIMAL HUMERUS TO STABILISE THE SHOULDER

FIVE YEARS’ EXPERIENCE

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A reduced retroversion angle of the humeral head may predispose to recurrent anterior shoulder dislocation and may also be a factor in persistent instability after soft-tissue repair. We performed rotational osteotomy of the proximal humerus in 20 patients with recurrent anterior shoulder dislocations (10 traumatic, 10 non-traumatic) and a decreased retroversion angle of the humeral head. The mean preoperative retroversion angle was 12°, which was increased after surgery to a mean value of 32°. All patients regained a normal range of shoulder motion and normal function within three months after surgery. At the five-year review all shoulders were stable, pain-free and had no radiological signs of osteoarthritis.

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Shoulder stability requires a proper balance between the humeral head and the glenoid cavity (Saha 1971; Rowe, Pierce and Clarke 1973; Glousman et al 1988). This balance depends on soft tissues, muscle function, and the skeleton of the humeroscapular joint. The importance of the rotator-cuff muscles for stability has been described (Kronberg, Németh and Broström 1990), and it has been shown that patients with generalised joint laxity often have a changed pattern of muscle activation (Broström, Kronberg and Németh 1989; Kronberg, Broström and Németh 1991). Movement between the humeral head and the glenoid cavity may also be altered by changes in the skeleton. Decreased retroversion of the humeral head has been found in many patients with recurrent anterior dislocation of the shoulder (Debevoise, Hyatt and Townsend 1971; Pieper 1985; Kronberg and Broström 1990), and rotational osteotomy of the proximal humerus to correct the anatomy may be the treatment of choice (Kronberg and Broström 1991).

Our aim was to present the clinical and radiological results in the first 20 patients of a larger series in whom we performed a rotational osteotomy of the proximal humerus to stabilise the shoulder.

PATIENTS AND METHODS

We examined clinically and radiographically 20 patients (17 men and 3 women) with recurrent anterior dislocation of the shoulder which required operative treatment. All had a retroversion angle of the humeral head of less than 20°. In ten (nine men, one woman) the dislocation was primarily due to trauma and in the other ten (eight men, two women) to generalised joint laxity. Their mean age was 30 years (20 to 47), their mean height 176 cm (160 to 192), and their mean weight 74 kg (50 to 94). All were right-handed. Eight patients were unstable on the dominant side and 12 on the non-dominant side. Two patients with a traumatic type of instability had each had two previous operations, Putti-Platt and then Bristow procedures, but both shoulders were still unstable (cases 1 and 14, Table I).

All 20 patients complained of uncontrollable instability and impaired shoulder function. They all had pain in association with subluxation or dislocation, but none had any signs of muscular weakness or nerve injuries. They were examined for generalised joint laxity according to the criteria of Carter and Wilkinson (1964). Patients who fulfilled at least four of the five stated criteria were included in the non-traumatic group, none of whom had a history of any injury or trauma to the shoulder. All patients in the traumatic group reported a definite injury, and none fulfilled more than two of the stated criteria for joint laxity. Shoulder stability was evaluated by the apprehension test (Rowe 1956; Gerber and Ganz 1984). The passive range of motion was measured with a goniometer with the patient in the standing position. All patients have been followed for at least 5 years (5 to 7).

Radiography. The retroversion angle of the humeral head was determined from a radiograph in the semi-axial view.
(Fig. 1) (Söderlund, Kronberg and Broström 1989). The 95% two-tail confidence interval (CI) for the normal retroversion angle is 30° to 35° for the dominant and 26° to 31° for the non-dominant shoulder (Kronberg, Broström and Söderlund 1990).

Before surgery and at the five-year review radiographs were taken in the standard AP and axial views and in 30° internal rotation for assessment of joint space and signs of osteoarthritis.

Table I. Details of 20 patients with recurrent dislocation of the anterior shoulder

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* T, traumatic; L, joint laxity

Operative technique. We used an anterior deltopectoral approach. The entire circumference of the humerus was exposed subperiosteally at the level for the osteotomy, 6 cm below the top of the humeral head (Weber 1969; Kronberg and Broström 1991; Broström, Kronberg and Söderlund 1993). The biceps tendon was protected in its sheath and a groove made with an osteotome to allow shift in millimetres to be measured. The humerus was then cut outside the capsule perpendicular to its long axis.
Rotation of 1 mm at the osteotomy level will give a change of the retroversion angle of approximately $2^\circ$ (1.3 to 3.0/mm) (Broström et al 1993; Söderlund, Kronberg and Broström 1994). The osteotomy was fixed laterally with a $90^\circ$ angulated six-hole semitubular plate and on the medioventral side with a straight two-hole semitubular plate (Fig. 2). The shoulder was immobilised for four weeks in an adducted and internally rotated position with a sling. Supported exercises were started on the first postoperative day and active exercises after four weeks.

We performed soft-tissue repair only on the first three patients in whom an arthroscopy had been indicated for inspection of the glenoid labrum. In these three shoulders the subscapularis tendon was shortened by 1 cm at closure.

Statistical methods. Mean values and standard deviations (sd) were calculated. Student’s $t$-test was used for statistical analysis.

RESULTS

Humer al head retroversion – stability. All shoulders for operation had a retroversion angle of less than $20^\circ$ (Table I). The mean ($\pm$ sd) retroversion angle for both types of instability was $12 \pm 5.1^\circ$ and in the non-traumatic group $13 \pm 5.0^\circ$. After surgery, the mean humeral-head retroversion for both groups was $32 \pm 6.6^\circ$, and the mean correction $20 \pm 6.8^\circ$.

In the traumatic group the contralateral shoulder was stable in nine patients. The mean humeral head retroversion for the stable shoulders was $27 \pm 3.6^\circ$. For the patient with bilateral instability the contralateral unstable shoulder had a retroversion angle of $22^\circ$.

In the non-traumatic group, the contralateral shoulder was stable in six patients. The mean humeral-head retroversion for the stable shoulders was $29 \pm 6.5^\circ$. Four patients with bilateral instability had an average retroversion angle of $26 \pm 5.8^\circ$ for the non-operated shoulder.

There were no cases of infection, nonunion or neurological complications. At follow-up after five years all shoulders were stable, both subjectively and at clinical examination using the apprehension test (Rowe 1956; Gerber and Ganz 1984). There were no clinical or radiological signs of osteoarthritis. In six patients the semitubular plates were removed because of local symptoms. All these shoulders were symptom-free at the five-year review.

Clinical examination. Before surgery flexion was decreased in three patients and abduction in two; in these the mean flexion was $130^\circ$ and the mean abduction $110^\circ$. After surgery all 20 shoulders became stable and pain-free and within three months all patients had regained a normal range of shoulder motion. Both flexion and abduction recovered to $180^\circ$ in all. External rotation in a neutral position was $62 \pm 14.3^\circ$ before surgery and $70 \pm 16^\circ$ after surgery. In $90^\circ$ abduction external rotation was $91 \pm 16.5^\circ$ before surgery and had increased to $97 \pm 12.0^\circ$ after surgery. Internal rotation in $90^\circ$ abduction was $79 \pm 21.8^\circ$ before surgery and had decreased to $71 \pm 17.0^\circ$ after surgery. The differences in rotation were not significant. Activities of daily living
became normal and all patients were able to return to their previous occupation within three months.

At the clinical review five years after surgery, all shoulders remained stable and pain-free, and shoulder function was excellent. Radiological review showed consolidated osteotomies and a normal joint space with no signs of osteoarthritis.

**DISCUSSION**

Previously, we have shown that many patients with shoulder dislocations have an abnormal retroversion angle of the humeral head and it has been suggested that this may make the shoulder more vulnerable to anterior dislocation (Pieper 1985; Kronberg and Broström 1990). Decreased humeral-head retroversion may be one important factor in persistent anterior shoulder instability after soft-tissue repair (Kronberg, Broström and Posch 1993).

The balance between the humeral head and the glenoid cavity is important, but since the variation in glenoid tilt is rather small, an osteotomy of the proximal humerus can be very valuable in patients with problems of anterior instability (Kronberg and Broström 1991). If necessary the osteotomy can be combined with the repair of a Bankart lesion, tightening of a lax capsule or with shortening of the subscapularis tendon. In the first three patients of our series, one with traumatic and two with non-traumatic dislocation, we performed shortening of the subscapularis tendon (Table I). In subsequent operations, however, all shoulders have been stabilised by a corrective extracapsular osteotomy without soft-tissue repair or arthroscopy.

All our patients regained excellent shoulder function with a normal range of movement within three months of operation. This short rehabilitation period is a result of not opening the joint capsule and not interfering with the rotator cuff. During operation we aimed to correct the retroversion angle to about 30°. There is, however, some variation in the postoperative retroversion angle mainly because of the elliptical cross-sectional area of the proximal humerus, and also difficulties in performing a perfect perpendicular osteotomy. In our series, postoperatively most angles were within the normal 95% two-tail CI. In the first patient (case 1), the retroversion angle was overcorrected (52°), but clinically the outcome was excellent with a stable joint and normal function. This patient had had two previous operations and the bony landmarks were difficult to define both at operation and on radiographs.

We have used this type of rotational osteotomy for 50 patients with anterior shoulder instability and have had no problems with the surgical technique or with bone healing (Kronberg and Broström 1991). The series reported here is the first 20 patients who have been followed for at least five years. All patients have stable, pain-free shoulders with a normal range of movement and all have returned to their previous occupation and sport such as wrestling, soccer, ice-hockey, tennis and professional dancing. We have seen no clinical or radiological signs of osteoarthritis in the humeroscapular joint.

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**REFERENCES**


