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Effectiveness of glenoid osteotomy in atraumatic posterior instability of the shoulder associated with excessive retroversion and flatness of the glenoid

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Abstract In this investigation, patients with atraumatic posterior instability of the shoulder were appraised in order to evaluate the effectiveness of glenoid osteotomy in the correction of excessive retroversion and flatness of the glenoid. In a series of 32 patients, 17 with posterior instability had no history of trauma. Posterior glenoid osteotomy was performed to correct excessive retroversion and to deepen the glenoid; 95% were re-examined after 5 years. In 81% the results were rated as good or excellent (Constant-Murley and Rowe scores), only 12.5% having had a recurrence. The glenoid could be deepened and on average the angle could be altered from -9.35° to -4.62° . In comparison, 50 volunteers had average angles of -4.4° , thus differing significantly from the preoperative group. Twenty-five per cent of the patients showed postoperative degenerative changes in the glenohumeral joint. The study shows that excessive retroversion and flatness of the glenoid in persons with atraumatic posterior instability can be successfully treated by a posterior glenoid osteotomy. Nevertheless, the high rate of postoperative degenerative changes must be taken into account.

Résumé Dans cette étude, nous avons examiné l'efficacité de l'ostéotomie glénoïdienne, pour la correction d'une retroversion excessive et d'un défaut de concavité glénoïdienne, chez les patients souffrant d'une instabilité postérieure de l'épaule non-traumatique. 17 des 32 patients n'ont pas eu d'antécédents traumatiques. L'ostéotomie postérieure glénoïdienne a été réalisée pour corri-

ger l'excès de retroversion et pour rendre concave la cavité glénoïdienne. 95% des malades ont été revus à plus de 5 ans de recul. 81% des résultats ont été classés bons ou excellents, seulement 12.5% ont récidivé. La gléne a pu être rendue concave et l'angle de rétroversion est passé en moyenne de -9.35° à -4.62° . En comparaison, un groupe de 50 volontaires avait en moyenne 4.4° , ce qui diffère significativement du groupe de patients en préopératoire. 25% des malades ont évolués vers une arthrose gléno-humérale. Cette étude montre que l'excès de retroversion et le défaut de concavité associés à une instabilité postérieure de l'épaule atraumatique peut être traité par une ostéotomie postérieure de la gléne avec un excellent résultat dans la plupart des cas. Mais cependant un pourcentage important d'évolution arthrosique de l'articulation gléno-humérale doit être pris en considération.

Introduction

A large number of factors influence the stability of the glenohumeral joint. In addition to the dynamic stabilisers, which provide a compressive load throughout the range of motion of the glenohumeral joint [23], a number of static stabilisers, such as the capsule and its ligaments [10, 15, 25, 34], adhesion and cohesion [22], and the negative intra-articular pressure [6, 18] play an important role. Other passive factors which contribute to the stability of the joint, are the concavity of the glenoid [23], the increased cartilage thickness in the periphery [33] and the glenoid labrum [13, 19, 20, 28]. The glenohumeral index [31, 35], and the degree of retroversion [3, 27, 31] are a reflection of the stabilising articular components.

The success of the treatment of posterior shoulder instability depends on the pathogenesis of the condition [8, 12]. Burkhead and Rockwood [4] were able to show that 80% of their patients with atraumatic instability could be treated successfully, in contrast to only 16% of those with a traumatic origin. On this basis, it is necessary to take into account the cause of the posterior shoulder in-

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stability, when planning surgical management. This point was not mentioned in the majority of the previous studies [24, 29, 32], and could be the reason for the high recurrence rates which were reported. This contention is supported by Bigliani et al. [1] who, by taking into account the underlying pathology of the condition, were able to achieve good or very good results in a high percentage of patients with posterior instability. The majority of their patients had capsular laxity, mostly without a history of trauma. These authors regarded increased retroversion of the glenoid as a contraindication to their treatment, which consisted solely of posterior capsular shift. In 1986, Brewer et al. undertook posterior glenoid osteotomy in patients with increased retroversion; their results were good, but they had only operated on 5 patients [3].

In our hospitals, excessive retroversion and flattening of the glenoid were observed in persons with atraumatic posterior instability. We therefore performed glenoid osteotomy in order to alter the angle of retroversion and to deepen the glenoid.

The aim of this study was to examine the long-term results of glenoid osteotomy, with special reference to the rate of recurrence in patients with atraumatic posterior instability and to investigate the extent of glenoid retroversion before and after operation.

Material and methods

Between 1983 and 1994 we operated on 32 patients with unidirectional posterior shoulder instability. Seventeen of the 32 had no history of trauma, while the other 15 patients had suffered from trauma or repetitive microtrauma. One of them was able to voluntarily dislocate the shoulder joint. Each underwent at least four months of intensive conservative treatment, with strengthening of the shoulder muscles, particularly of the rotator cuff, before the decision to operate was made. Three patients already had secondary posterior instability following an anterior stabilisation procedure which had been undertaken for primary atraumatic anterior instability. During surgery, special attention was paid to capsular laxity, labral lesions and the shape of the bony glenoid. None of the patients had capsular laxity or significant changes of the labrum, but several had an increased retroversion and flatness of the glenoid, especially in the posterior part. For these reasons posterior glenoid osteotomy was undertaken in all 17 patients. The osteotomy was begun 1 cm medial to the glenoid surface and was carried up as far as the middle of the glenoid (Fig. 1a) which was then slowly and carefully bent forwards. A prepared implant of autologous or homologous iliac crest was then inserted (Fig. 1b).

Sixteen patients were reassessed clinically and radiologically after an average of 5 years (range 1.7 to 10.8 years). This evaluation was made in terms of the Constant-Murley and the Rowe scores. Radiological assessment included an AP view in internal and external rotation, and an axillary view for determining the depth of the glenoid and the extent of the version. In some instances an axillary CT or MRI was undertaken as an alternative. The retroversion angle was measured by the method described by Saha in 1978 (Fig. 2). The same radiological evaluation had been made preoperatively, and the pre- and postoperative degrees of retroversion of the glenoid could therefore be compared. Particular attention was paid to degenerative changes in the glenohumeral joint both before and after the operation.

For comparison, radiographs of a control group of 50 patients without any history of instability or other shoulder disorders were evaluated, and the retroversion angle of the glenoid was determined, as described for the patients in the series.

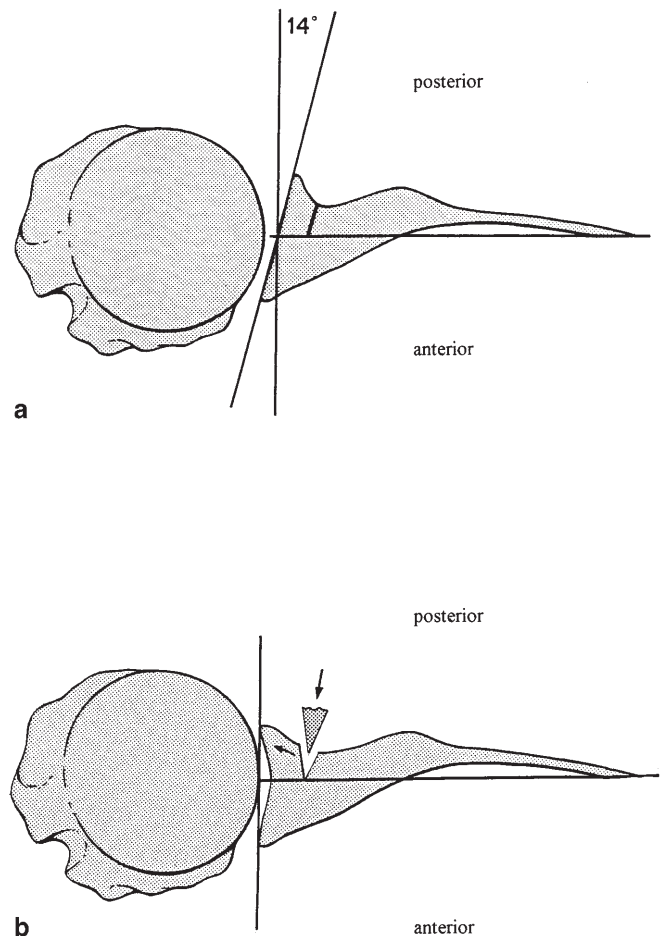


Fig. 1a, b Schematic drawing of glenoid osteotomy. **a** Axial image of a glenohumeral joint with excessive retroversion (-14°). The technique of retroversion angle determination is described in Fig. 2. The osteotomy is performed 1 cm medial and parallel to the articular surface of the glenoid. **b** Finally, after carefully bending the glenoid forward a prepared bone block is inserted and a normal retroversion angle restored

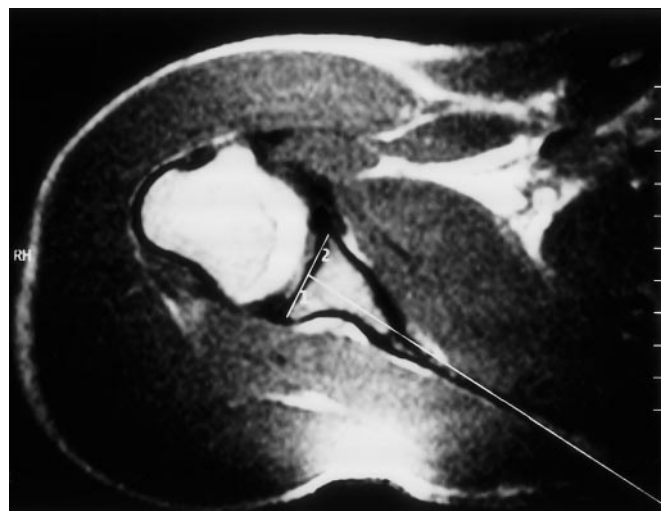


Fig. 2 Axial MR image for determining the extent of glenoid version using the method described by Saha in 1978. *Line 1* from the anterior to the posterior point of the glenoid. *Line 2* from the middle of line 1 to the medial border of the glenoid. The retroversion angle is the angle between *line 1* and *line 2*

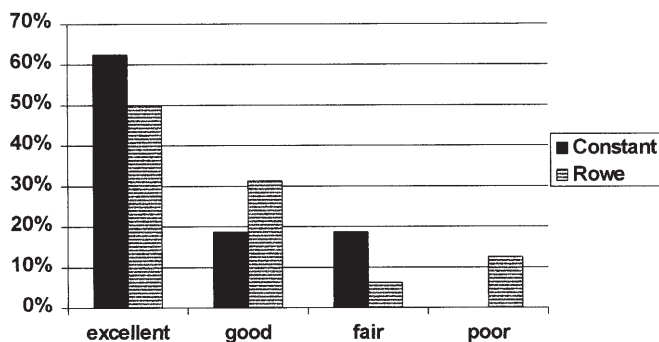


Fig. 3 Clinical results in the Constant-Murley and in the Rowe score

Statistical analysis of the pre- and postoperative values of the retroversion angles in the patients and the control group was performed using the student t-test for paired and unpaired couples.

Results

Clinical results

Eighty-one per cent of the patients showed a good or excellent outcome either in the general shoulder-function score (Constant-Murley) or in the special dislocation score (Rowe) (Fig. 3). A difference between the two scores was obvious only for the patients with fair and poor results. In 2 patients (12.5%) instability recurred postoperatively. In both these instances the retroversion angle and the depth of the glenoid had been corrected to a normal value. Obvious limitation in the range of motion, especially for rotation, was found in only one person. Apart from these three individuals, the other patients were all able to carry out their daily tasks satisfactorily, and 69% could play games which involved raising their hands above their heads at a higher standard than before operation. Twelve out of 16 patients (75%) were very satisfied with the result, one patient was marginally satisfied and the other three patients (19%) were not satisfied.

Complications such as loosening of the implant, infection or nerve injury did not occur.

Radiographical findings

In the 17 patients with a history of posterior atraumatic instability, the preoperative degree of glenoid retroversion amounted to a mean of -9.35° (range -4.5° to -17°) (Fig. 4). By comparison, the degree of retroversion after surgery was significantly reduced to a mean of -4.62° (range $+1^\circ$ to -5°) ($P < 0.05$) (Fig. 4).

The degree of glenoid version in the healthy control group averaged -4.4° (range $+5^\circ$ to -11°) (Fig. 3), showing no obvious difference to the instability group after treatment. A significant difference ($P < 0.02$) was found, however, between the control and the preoperative groups.

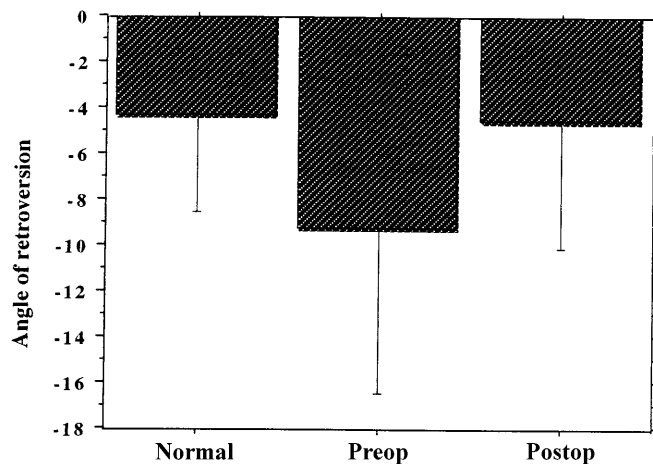


Fig. 4 Mean of glenoid retroversion in all three groups. There are statistically significant differences ($P < 0.05$) between the pre- and postoperative groups and between the control and preoperative groups. On the other hand, there were no significant differences between the postoperative and the control groups

Mild preoperative degenerative changes in the glenohumeral joint were present in one patient. Postoperative degeneration, which was no more than moderate, was detected in 4 patients (25%).

Discussion

Numerous biomechanical experiments [2, 9, 13, 20, 21, 23, 33, 35] and EMG-studies [7, 16, 26] have led to a better understanding of shoulder instability, and it has been shown that a number of different factors influence the stability of the glenohumeral joint. In addition to dynamic stabilisers such as the rotator cuff, passive restraint plays an important role. The labrum and the capsulo-ligamentous complex are considered to be the main source of anterior stability [10, 13, 19, 20, 25, 28, 34]. The posterior part of the labrum is much less well developed, and the capsule is much thinner posteriorly. For these reasons the joint components themselves, particularly the depth of the glenoid [23] and the degree of glenoid retroversion, are regarded as the more important factors [3, 31, 33] in posterior shoulder instability.

Anatomical studies have established that a normal retroversion angle is about -4° [31]. We have been able to confirm this value by measurements in a healthy control group of 50 volunteers. Their average retroversion angle was -4.4° . In our patients with unidirectional posterior instability, excessive retroversion (average -9.35°), as much as -17° in some individuals, could be determined. Intra-operatively they were all found to have obvious flatness of the glenoid, especially of the posterior part. On the supposition that these factors could be the reason for their joint instability, we performed a posterior glenoid osteotomy to normalise the retroversion and to deepen the glenoid. Postoperative radiographs revealed a normal degree of retroversion (-4.62° in average), and a sufficient concavity of the glenoid, which both could be

increased by osteotomy. This approach facilitates reduction of the amount of translation in the glenoid in persons with posterior instability, as has been demonstrated by Matsen et al. [23].

It must be emphasised that the determination of the depth and extent of the retroversion of the glenoid is limited by conventional radiography because the articular cartilage and the soft tissues such as the labrum cannot be visualised. Nevertheless, the bony glenoid is the structure where the operation is performed and the joint reaction force is applied and may therefore be sufficient to demonstrate the main effect of the operation.

Clinical follow-up has revealed that posterior glenoid osteotomy leads to good or excellent results in 81% of patients. In comparison to other forms of surgical treatment of atraumatic posterior instability this is a very encouraging result [11, 14, 29], and bears comparison with those achieved by Bigliani et al. in 1995. These authors treated capsular laxity by a posterior inferior shift and they considered increased retroversion of the glenoid to be a contraindication for this soft tissue operation. In our investigation all capsules were thinner posteriorly and showed no laxity. We also found no lesions of the labrum but increased retroversion and flatness of the glenoid; for these reasons we performed posterior glenoid osteotomy.

In previous studies [8, 17, 22, 36] progressive degeneration of the shoulder joint was mentioned as an undesirable consequence of glenoid osteotomy. We found mild degenerative changes in 25% of our patients after an average follow-up time of 5 years. One of these four patients had already shown slight signs of degeneration before the operation, so the changes must be attributed to the instability and not to the surgery.

This study has shown that excessive retroversion and flatness of the glenoid can predispose to posterior instability of the shoulder. Glenoid osteotomy is a successful operation for this condition but the relatively high rate of degenerative changes has to be taken into account.

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