Arthroscopic release of adhesive capsulitis

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Twenty-five patients with primary adhesive capsulitis underwent an arthroscopic release of the capsule of the shoulder joint. They were reviewed after a mean of 14.8 months (range, 3-40 months). Night pain and awakening were a feature in all 25 patients preoperatively but were only found in 3 postoperatively. There was marked improvement in pain from a preoperative visual analog scale score of 3.1 to a postoperative visual analog scale score of 12.6 on a scale of 15. Passive movement of the joint improved significantly, with mean passive elevation changing from 73.7° preoperatively to 163° postoperatively, mean passive external rotation changing from 10.6° preoperatively to 46.8° postoperatively, and passive internal rotation improving by a mean of 9 levels. The mean preoperative Constant score of 25.3 improved to 75.5 postoperatively, and the Constant score adjusted for age and gender averaged 91%. All patients completed the Short Form–36 questionnaire at their review, revealing a norm-based physical summary score of 48.7, falling within 1 SD of a normal population sample. This arthroscopic surgical technique is derived from the open surgical release. It is founded upon an understanding of the pathology of this condition. It appears to yield rapid relief of pain and dramatic improvement in movement and function in this painful and otherwise protracted condition. (J Shoulder Elbow Surg 2004; 13:180-5.)

Codman's original description of the clinical picture of adhesive capsulitis[3] is still considered to be the most accurate. The natural history of this chronic fibrosing condition has long been considered self-limiting with full recovery between 18 and 24 months,[3,6,27] making invasive treatment modalities superfluous. However, more recent literature has reported less optimistic outcomes, with a protracted course and incomplete recovery.[23,26] Resistance to antiinflammatory drugs, intraarticular injections, physiotherapy, or manipulations, therefore, warrants surgical treatment.[7] Neviaser[16] reported his results of open capsulotomy in 1945. This was performed out of scientific interest and explicitly not for treatment purposes, and surgical release of the contracted tissue has been used only in limited numbers.[14,15,19,23] Ozaki et al[19] reported good results from open surgical release, and the senior author reported in detail on the results of open surgical release of the coracohumeral ligament in 25 patients.[18] Applying the same surgical principles with an arthroscopic approach could yield equally favorable results, with less soft-tissue dissection and shorter operation time. We now report on the clinical outcome of the arthroscopic release of the rotator interval and the coracohumeral ligament for primary adhesive capsulitis.

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MATERIALS AND METHODS

Between January 1999 and December 2001, 154 patients attended the shoulder clinic with shoulder stiffness, diagnosed as primary frozen shoulder according to Codman's criteria. Of these, 61 (40%) were treated conservatively with antiinflammatory medication, physiotherapy, and intraarticular injections, and 42 (27%) underwent manipulation under anesthesia. The cases of the remaining 51 patients (33%) were considered to be beyond conservative management and underwent surgical release, the majority arthroscopically (88%). Open release was performed if the joint was too contracted for arthroscopic maneuvers. Of the 45 arthroscopic releases, 25 were available for reassessment. There were 12 male and 13 female patients. Six had insulin-dependent diabetes, and one had Dupuytren's disease. Their mean age was 50.8 years (range, 41-61 years; median, 51 years). The dominant side was affected in 48%. The time from onset to index procedure averaged 13.6 months (range, 2-24 months; median, 12 months). All had conservative management during that period, with two undergoing manipulation under anesthesia. The indication for surgery was unresponsiveness to conservative measures or extreme disability. All patients had pain awakening them at night, and 88% had disability with their activities of daily living. They scored a mean of 3.1 points on a visual analog scale (VAS) of 15. The mean preoperative range of motion was as follows: 73.4° for elevation (range, 30°-140°; median, 70°), 10.6° for external rotation (range, 0°-40°; median, 10°), and 3.4 points on the American Shoulder and Elbow Surgeons score[24] for internal rotation, corresponding to the level between the sacrum and the gluteal line. The mean Constant score[4] of 25.3 at this stage ap-

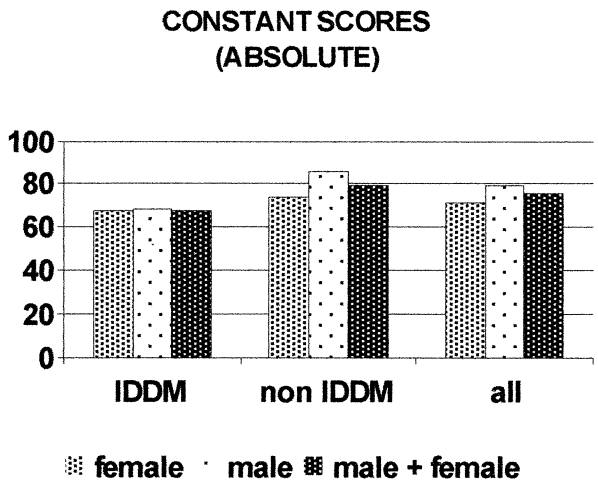

Figure 1 Postoperative Constant scores, subdivided for diabetic status and gender. *IDDM*, Insulin-dependent diabetes mellitus.

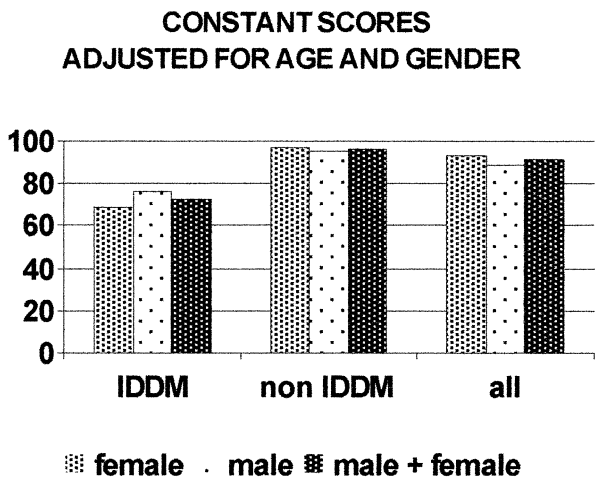

Figure 2 Postoperative adjusted Constant scores, subdivided for diabetic status and gender. *IDDM*, Insulin-dependent diabetes mellitus.

peared to be irrelevant, as only 10 patients were able to elevate up to 90°. The partial Constant score, after the category for power was omitted, averaged 19.6 out of 75 points (range, 4-34.5 points; median, 19 points). All patients were operated on by the same surgeon.

Operative procedure

The operation is performed under scalene block and general anesthesia with the patient positioned in the lateral decubitus position. The success of the procedure depends upon good visualization, making an arthroscopic pump set between 50 and 100 mm Hg essential. A standard posterior portal is established to perform a diagnostic arthroscopy in a standardized sequence, starting with the long head of the biceps. Typically, abundant angiogenesis is found, especially in the rotator interval area. In the majority of patients, the joint is too contracted to examine the infraglenoid recess until the release is well under way. The anterior portal is made inside out by advancing the scope in the rotator interval, just above the subscapularis tendon and as far lateral as possible. A unipolar diathermy probe (Mitek VAPR; Ethicon Inc, Westwood, MA) is introduced into the joint. The release starts by dividing the middle glenohumeral ligament from the edge of the labrum. The subscapularis is usually covered in scar tissue, much like a sequestrum is covered by an involucrum. This scar tissue is excised until the glistening fibers of the tendon appear. The capsule is further released from the labrum until the muscle fibers of the subscapularis are clearly visible down to the 4-o'clock position. It is very important to maintain a good flow through the joint, or to keep washing it out, to ensure that the temperature remains low during this procedure, for the joint volume is small, and the diathermy must not be allowed to heat the irrigation fluid. The rotator interval is then released from the anterior edge of the supraspinatus tendon to the upper margin of the subscapularis. One has to be careful not to damage the supraspinatus, as its leading edge is enveloped in scar as well. All of the tissue in this area is then excised until the inferolateral bony surface of the coracoid process is well within view. The biceps is left

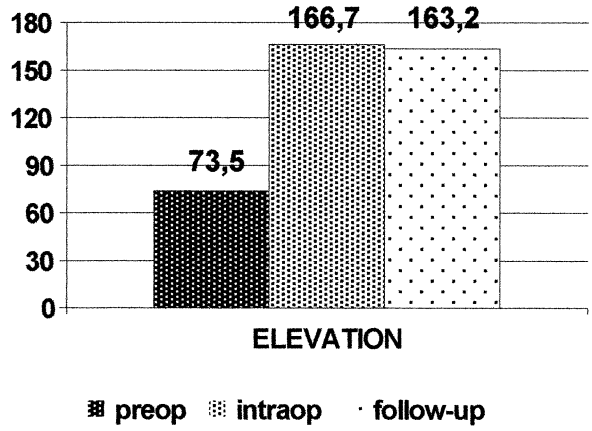

Figure 3 Passive elevation (in degrees) (preoperatively, intraoperatively, and postoperatively).

spanning the space where the rotator interval has been excised. The capsulotomy is extended further posteriorly behind the long head of the biceps origin, working just at the edge of the labrum, until the 9-o'clock position is reached. No attempt is made to divide the inferior capsule with the diathermy, as the axillary nerve is immediately adjacent to the undersurface of the inferior capsule. The joint is washed out, and 10 mL of 0.5% bupivacaine and 25 mg hydrocortisone acetate is instilled through the arthroscopic cannula before withdrawal from the joint. After the patient is repositioned in the dorsal decubitus position, the joint is manipulated into full elevation, which tears the inferior capsule, thus completing the release. Rotation is then checked and is usually equal to that of the unaffected side. If lacking, a minor manipulation completes the release.

All arthroscopies confirmed the presumptive diagnosis of primary frozen shoulder. No concomitant pathologies were found. The intraoperative range of motion after release and

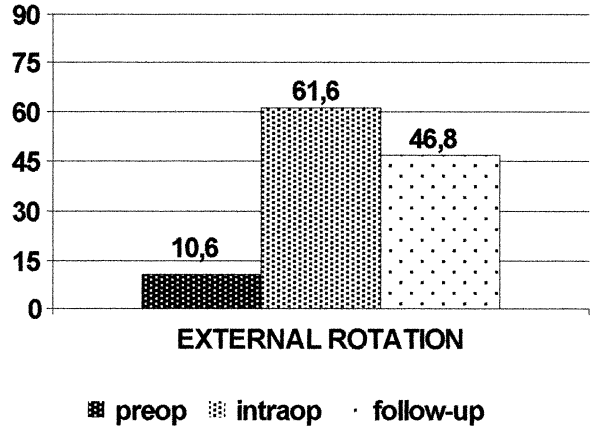

Figure 4 Passive external rotation with arm to the side (in degrees) (preoperatively, intraoperatively, and postoperatively).

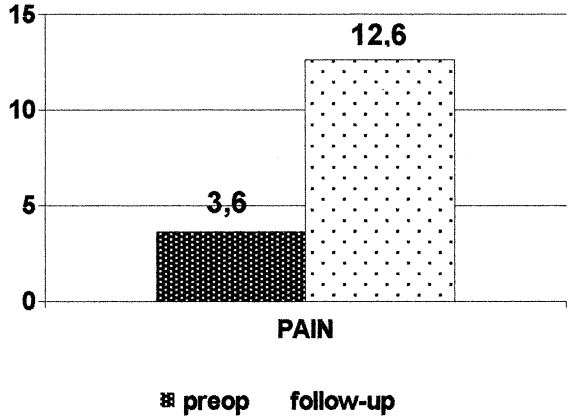

Figure 6 Pain as scored on a visual analog scale of 15 (preoperatively and postoperatively).

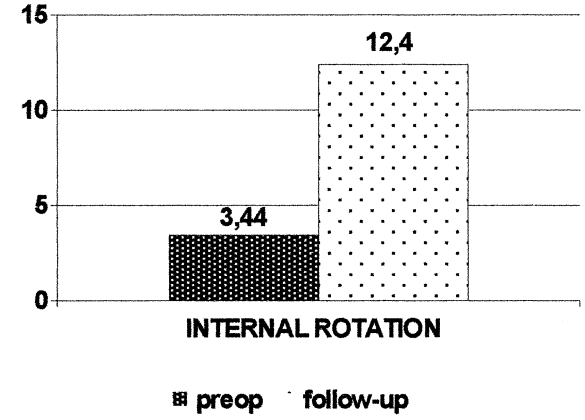

Figure 5 Internal rotation according to American Shoulder and Elbow Surgeons score (preoperatively and postoperatively).

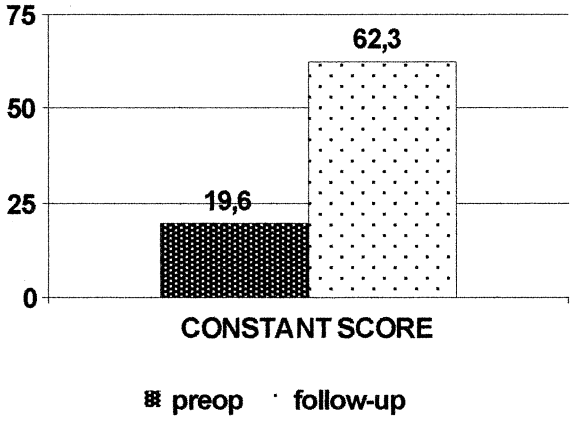

Figure 7 Constant score after omission of the category of power (preoperatively and postoperatively).

Table I Norm-based SF-36 scores (all categories and summary scores)

	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Score	82.5	67.3	69.3	68.3	62.0	82.6	84.0	74.6		
Mean	83.0	77.9	70.2	70.1	57.0	83.6	83.1	75.2	50.0	50.0
SD	23.8	35.3	23.4	21.4	21.1	23.0	31.6	17.6	10.0	10.0
NBS	49.8	47.0	49.6	49.2	52.4	49.6	50.3	49.6	48.6	50.9

PF, Physical functioning; *RP,* role physical; *BP,* bodily pain; *GH,* general health; *VT,* vitality; *SF,* social functioning; *RE,* role emotional; *MH,* mental health; *PCS,* physical summary score; *MCS,* mental summary score; *NBS,* norm-based score.

manipulation averaged 61.6° external rotation (range, 10°-90°; median, 60°) and 166.7° elevation (range, 110°-180°; median, 170°). The after-treatment protocol consisted of physiotherapy for a mean of 9.5 weeks (range, 2-36 weeks; median, 6 weeks) and an intraarticular steroid injection in 4 cases.

RESULTS

Of the patients, 36% had dramatic improvement in terms of pain relief and functional gain on the first postoperative day, and 88% within the first 2 weeks (mean, 4.2 days). The remaining 3 patients were only moderately satisfied in the immediate postoperative period. Five shoulders deteriorated again after a mean of 5.4 weeks, mainly because of recurring pain. At the time of review, 18 patients still considered their result as excellent, 3 as good, 2 as fair, and 2 as poor. None of the patients with deteriorations in the immediate postoperative period became ultimately very satisfied. Of those 3 patients who did not

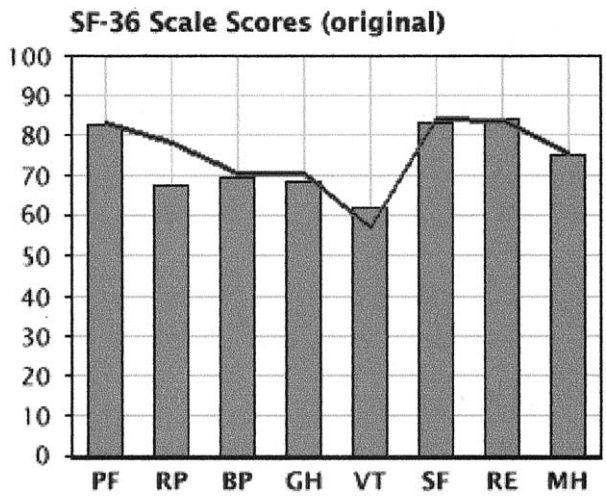

Figure 8 Mean Short Form–36 (*SF-36*) scale scores (all categories).

do very well within the first 2 weeks, 2 regarded their result at follow-up as poor and fair.

Follow-up averaged 14.8 months (range, 3-40 months; median, 15.2 months). The mean absolute Constant score was 75.5 (range, 40.6-97.7; median, 80.7), and the Constant score adjusted for age and gender averaged 91.1% (range, 45.1%-117.7%; median, 97.3%). As diabetic patients are known to have inferior results,[12] we recalculated after exclusion of these patients. This revealed a mean Constant score of 79.7, with a score of 96.4% when adjusted for age and gender (85.7 [95.4%] for men and 74.1 [97.4%] for women). The diabetic group had a mean of 67.8 points, with a score of 72.4% when adjusted for age and gender (67.9 [76.3%] for men and 67.8 [63.3%] for women) (Figures 1 and 2).

Analysis of the scores and comparison with the preoperative findings are shown in Figures 3, 4, 5, 6, and 7. Internal rotation in Figure 4 is scaled according to the American Shoulder and Elbow score.[24] The preoperative score of 3.4 corresponds to the level between the gluteal line and the sacrum. The postoperative score of 12.4 corresponds to the level of T9-T10. In Figure 6 the Constant score is incomplete, in that the category for power is omitted for reasons outlined above.

All reviewed patients completed the Short Form–36 questionnaire at their follow-up visit. The results showed that our population in general conforms to a normal population sample, as their norm-based physical summary scores are within 1 SD (Table I, Figures 8 and 9).

DISCUSSION

The pathology of adhesive capsulitis has been recognized as the deposition of scar tissue in the shoulder joint capsule.[2,16] Open surgical exploration showed that the coracohumeral ligament is palpably the most thickened and abnormal part of the capsule.[9,15,18] Arthroscopy confirmed the rotator interval to be the most affected area of angiogenesis[30,31] and scar formation.[5] Open surgical release of the coracohumeral ligament and the rotator interval restored passive external rotation and relieved pain.[15,18,19] Although initially used as a diagnostic tool for associated pathology[22] or as an adjunct in joint distension,[11] arthroscopy has become commonly used in the actual treatment of adhesive capsulitis.[29] We used our experience from open surgery to refine the arthroscopic release for idiopathic adhesive capsulitis and target the area of greatest contracture, namely, the coracohumeral ligament. As this is an extraarticular ligament, it is only amenable for arthroscopic excision by removing the whole of the rotator interval. The inferolateral surface of the coracoid is to be exposed for complete release.

Several authors have reported on the results of arthroscopic capsular release but, unfortunately, reinforced the existing confusion around the term frozen shoulder by including shoulders requiring additional surgical maneuvers in the subacromial space. Furthermore, the capsulotomy is often extended into regions of the capsule that are not considered to be regularly involved in the pathologic process[29] or into the inferior recess, which can endanger the axillary nerve,[29] especially when electrocautery or motorized instruments are used. This study could be criticized because the number of cases is small, but with 25 cases of primary frozen shoulder, it is actually one of the largest series in the literature, for many reports with similar numbers are collections of both primary and secondary frozen shoulder.[1,21,22] Another criticism is that the minimum follow-up is short, but this is a condition that never recurs once it is better, so it is unlikely that the results would deteriorate with time. In a very mixed population, Pollock et al[22] performed arthroscopy after manipulation under an interscalene block to debride the glenohumeral joint and the subacromial space. Sectioning of the coracohumeral ligament was only occasionally required to increase range of motion further. Segmuller et al[25] only released the inferior capsule with the purpose of reproducing the traumatic disruption of the inferior capsule during manipulation in a controlled fashion. The majority of their patients had no residual restriction of external rotation at follow-up, but 50% had restricted internal rotation. The French multicenter study of Beaufils et al[1] reported on an anterior and anteroinferior release followed by a manipulation in 26 shoulders, 13 of which were primary frozen shoulders. The coracohumeral ligament needed release only in 1 case. They found little benefit in arthroscopic release of primary frozen shoulders, as the time to recovery

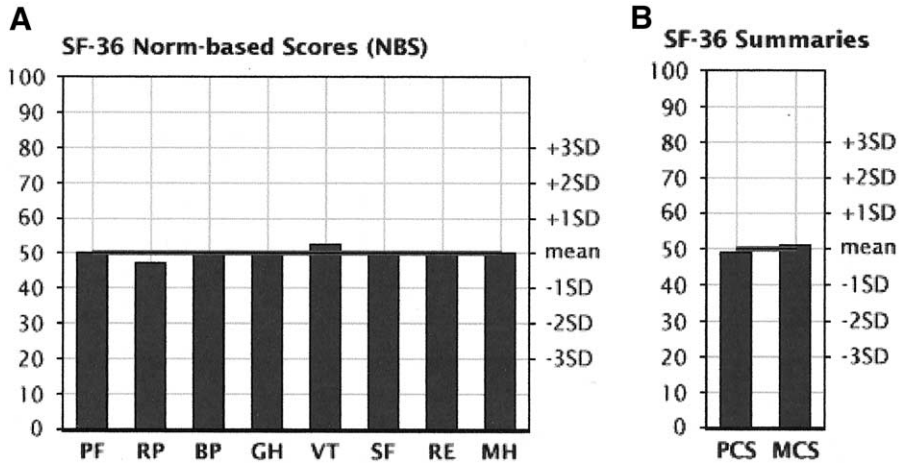

Figure 9 A, Diagram of norm-based Short Form–36 (*SF-36*) scores (all categories). **B**, Diagram of norm-based SF-36 summary scores.

was very long, and it did not relieve pain. Harryman et al[8] gave an excellent description of their 360° arthroscopic release, but in 13 of 30 included shoulders, an associated pathology was found. Furthermore, they routinely performed subacromial debridement of adhesions. Ogilvie-Harris and Myerthall[17] reported on their technique of anteroinferior capsulotomy in diabetic patients. They used a shaver to perform the capsulotomies, even in the axillary recess. In the interval area, only the synovitis was addressed. Nevertheless, 13 of 17 patients returned to full external rotation postoperatively. Pearsall et al[20] advocated sectioning the intraarticular component of the subscapularis tendon in addition to the anteroinferior capsule to restore external rotation, as they frequently observed rupture of the intraarticular subscapularis after manipulation. In an earlier report of their results in 43 patients, they found associated extensive subacromial fibrosis in 41%, requiring subacromial debridement.[21] In an uncertain percentage, an acromioplasty was necessary as well. Warner et al[28] found an acromioplasty to be indicated in 6 of 23 arthroscopic capsular releases for idiopathic adhesive capsulitis. Their capsulotomy consisted of a division of the rotator interval and was successful in 18 cases. The remaining 5 shoulders required further release of the anteroinferior capsule to allow external rotation in abduction. Yamaguchi et al[31] used the same technique in 23 shoulders, with only 1 failure requiring re-intervention. In the description of their technique, the thickened rotator interval was dissected until the coracohumeral ligament was well visualized but without division of the ligament itself. Holloway et al[10] used a very similar anterior release technique, but they completed the capsulotomy circumferentially. In their study of a mixed population, 11 primary frozen shoulders were included after exclusion of 9 diabetic patients, and 1 failure was encountered, which was attributed to biceps tendinitis. Likewise, Jerosh[13] reported very favorable and durable results with a 360° release in 28 patients with primary frozen shoulders.

Clearly, arthroscopic capsular release appears to be a successful procedure for the stiff shoulder. However, we find the inclusion of a mixed population to be a shortcoming in most of the published series. If subacromial debridement or an acromioplasty is found to be indicated, it is unlikely that these patients have primary adhesive capsulitis. Furthermore, we question the necessity of a circumferential capsulotomy and agree with Warner[29] that releasing the inferior capsule jeopardizes the axillary nerve. We believe that treatment should be directed at the rotator interval and the contracted coracohumeral ligament, as this is the site of the primary pathology in idiopathic adhesive capsulitis. Additional sectioning of the middle glenohumeral ligament and debridement of the scar tissue around the subscapularis tendon result in immediate and full external rotation. Extension of the capsulotomy to the posterosuperior capsule is thought to accelerate the restoration of internal rotation. In contrast to Pollock et al,[22] we advise completion of the capsular release into the axillary recess with a manipulation in elevation after surgical restoration of external rotation. This requires less force, as elevation is facilitated by the coupled motion of external rotation.

In conclusion, the arthroscopic release described in this study appears to be a safe and quick procedure for the treatment of idiopathic adhesive capsulitis, with rapid and durable relief of pain and functional gain in the majority of patients.

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