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ORIGINAL STUDY

Thermal capsulorrhaphy in internal shoulder impingement : A 7-year follow-up study

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This study aimed to evaluate the long-term results of arthroscopic thermal shrinkage of the anterior capsule in athletes with internal shoulder impingement. In recent years, opinion with regards to the aetiology of internal shoulder impingement has changed significantly. The traditional treatment of internal impingement consisted of debridement of labral and/or undersurface cuff lesions. The use of concomitant thermal capsulorrhaphy, based on the concept of anteroinferior laxity, has also been advocated with excellent short-term results. In this study we investigated the long-term effects of this technique.

Twelve overhead athletes with internal impingement underwent traditional arthroscopic treatment plus thermal capsulorrhaphy for internal impingement. All patients were evaluated 1, 2 and 7 years postoperatively using a questionnaire regarding their sports activity, and the modified Rowe score.

At 1, 2 and 7 years postoperatively there was a significant improvement in the modified Rowe score when compared to the preoperative scores. However, follow-up at 7 years showed a significant deterioration of the initial 1 and 2 year results ($p < 0.001$), with only 25% of the athletes able to perform sports at their preoperative level.

Conclusion : Excellent short-term results with thermal capsulorrhaphy, in addition to traditional arthroscopic treatment, in patients with internal shoulder impingement were not sustained over time. After 7 years, only 25% of the athletes were able to perform sports at their preoperative level.

Keywords : thermal capsulorrhaphy ; radiofrequency ; shoulder ; internal impingement.

INTRODUCTION

Overhead athletes are prone to several types of shoulder pathology (*11*). Internal impingement has been described as a possible mechanism of injury, resulting in intra-articular lesions, such as cartilage, labral or rotator cuff lesions (*8*). Internal impingement is a condition where the physiologic contact between the labrum and the cuff during overhead motion becomes pathologic. The underlying pathophysiology of internal impingement has been a subject of debate. Walch *et al* found that repetitive contact between greater tuberosity and the posterosuperior glenoid could lead to labral and rotator cuff damage in the athlete (*25*). Burkhart and Morgan (*4*) postulated that the pathological cascade starts with a tight posteroinferior capsule, leading to an internal rotation deficit and a shift in the glenohumeral rotation point. In their "circle concept",

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arthroscopic selective posteroinferior capsulotomy/repair of the peel-back lesion is the key to successful surgery. Jobe (*14*) and Davidson *et al* (*7*) attributed the pathologic findings to acquired anteroinferior microinstability.

Results of arthroscopic debridement and/or labral repair are poor (*7,15,21*) and several authors advocate the addition of a stabilizing procedure such as arthroscopic capsular plication, thermal capsulorrhaphy, or open anterior capsular-labral reconstruction in the treatment of patients with symptomatic internal impingement (*14,9,17*).

For a period, arthroscopic thermal capsulorrhaphy was a very popular option to stabilize the shoulder. Levitz *et al* (*17*) reported a 90% success rate of arthroscopic thermal capsulorrhaphy in baseball players with internal impingement at 30 months after surgery. Other clinical studies however show widely varying success rates (*9,13,14*).

There is a paucity of reports in the literature on the long-term results of thermal capsular shrinkage in the overhead athlete diagnosed with internal impingement, and it is not known how these results will change with time. The goal of this study was to prospectively examine the long-term results of the treatment of internal impingement with thermal capsulorrhaphy.

PATIENTS AND METHODS

Between March 1997 and November 1999, twelve athletes, suffering from internal impingement not responding to conservative treatment, were treated with arthroscopic thermal capsulorraphy. Only high level, overhead athletes with longstanding pain in their dominant shoulder were included prospectively.

Patients were included if clinical examination showed posterior shoulder pain in 90° of abduction, hyperextension and external rotation and a positive relocation test (*7*). Exclusion criteria included a history of surgery, dislocation, marked instability or laxity, external impingement, Bankart or HAGL lesion (humeral avulsion of the glenohumeral ligament) and cartilage damage. All patients were treated with intense physiotherapy, for at least 3 months prior to surgery. Those patients failing to respond to physical therapy were treated with an arthroscopic thermal capsulorrhaphy.

All procedures were performed under general anaesthesia with endotracheal intubation. Patients were positioned in lateral decubitus. Longitudinal traction of 4 kg and vertical upper arm traction of 3 kg was applied to the affected arm. A standard posterior portal and a low anterior arthroscopic portal were made using an outside-in technique. An infusion pump provided inflow at a constant pressure of 30 mmHg. During arthroscopy, shoulders were routinely checked for capsular laxity (Fig. 1A-1B), SLAP lesions of the labrum, articular surface tears or fraying of the supraspinatus tendon, and the presence of a Hill-Sachs lesion. Glenohumeral laxity was confirmed when external rotation range exceeded 100°, anterior translation was possible beyond 50% and when the arthroscope could be moved freely between the humeral head and the glenoid (positive drive-through sign).

If necessary, debridement of non-detached labral tears and articular sided partial rotator cuff tears was performed. All patients in whom glenohumeral laxity was confirmed at the beginning of the procedure had thermal capsular shrinkage performed as an adjuvant. An Oratec monopolar radiofrequency probe (ORATEC Interventions, Menlo Park, California, USA) was used, producing a constant temperature of 65°C at the tip of its probe, at a power of 40 Watt. The technique of capsulorrhaphy consisted of slowly "painting" the shoulder capsule, through the anterior portal. The inferior glenohumeral ligaments were treated first, followed by advancement of the probe superiorly to the rotator interval. Next, the probe was switched to the posterior portal and the posterior inferior portion of the inferior glenohumeral ligament was treated.

Rehabilitation consisted of immobilization of the affected arm in a sling for 4 weeks. Then passive range of motion exercises were initiated, avoiding the last 15° of external rotation. At the same time, strengthening exercises for the rotator cuff muscles and deltoid muscle were started, as well as scapulothoracic stabilization exercises. At 8 weeks, postoperatively chest press and pull exercises and a complete shoulder conditioning and endurance program were included in the program. At 13 weeks, overhead flexion and throwing with the operated arm were allowed. Return to full sport activity without any restriction was allowed at 4 months postoperatively.

Patients were evaluated preoperatively and at 1, 2 and 7 years postoperatively. A modified Rowe score (*15,24*) was obtained from all patients at each visit (Table I).

At seven years postoperatively, a Visual Analog Scale for pain was additionally used. The patients were also given a questionnaire (Table II) to assess their level of sport, satisfaction regarding the surgery and whether or not revision surgery was done. Patients were also asked

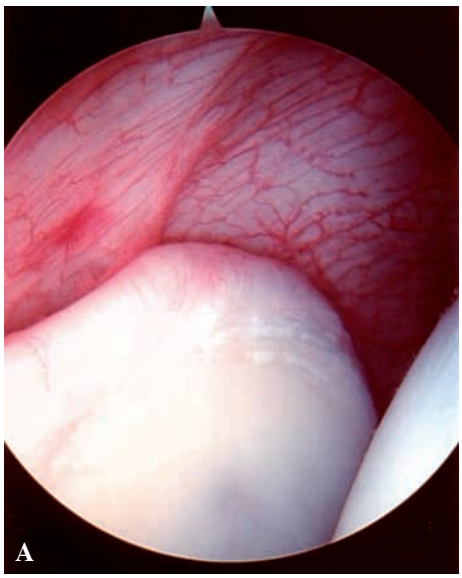

Fig. 1A. — Posterior portal view of the shoulder illustrating laxity of the anterior capsule.

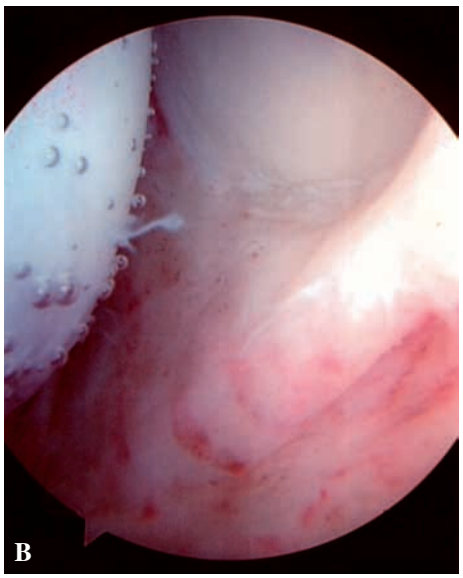

Fig. 1B. — Posterior portal view after thermal capsulorrhaphy shows tightening of the anterior capsule.

Table I. — Modified Rowe Scale

pain	15
stability	30
motion	10
function	50

if they would undergo the procedure again. Sports level was defined as : recreational (participation 2-3 times/ week, no official ties with a team or competition) ; amateur (member of a second or third division team) ; professional (member of a first division team) ; or national (elite athlete on the national team) (Table II).

Statistical analysis was done with use of Graphpad PRISM 5.00 (Graphpad, San Diego, USA). A repeated measures ANOVA test with Bonferroni's multiple comparison test was used to analyze the results of the modified Rowe score.

RESULTS

Ten men and 2 women were included in this study. All patients were high level overhead athletes who performed in different sports (volleyball (4), tennis (4), baseball (3), swimming (1)). Age at the time of surgery ranged from 23 to 34 years (average 27 years).

All athletes had some of the classic lesions of internal impingement. Fraying of the posterosuperior labrum was found in seven shoulders. One shoulder showed minor fraying of the anterior labrum, and another shoulder showed a small posterosuperior cartilage lesion. In six shoulders, a partial articular sided tear of the posterior part of the supraspinatus tendon was found. All lesions were treated by debridement alone. No complications occurred.

Preoperatively, the average modified Rowe score was 45.8 (range 35-50). At 1 and 2 years postoperatively, the average scores were 89.5 (range 60-100) and 90.4 (range 80-100) respectively. The modified Rowe score at 7 years postoperatively was 70.4 on average (range 60-100). The 1-, 2- and 7-year modified Rowe scores showed a significant improvement from the preoperative scores ($p < 0.0001$). The 7-year score was significantly decreased from the 1- and 2-year follow-up ($p < 0.001$) (Fig. 2). The average VAS score for pain at the 7-year follow-up was 4.8 (range 0-9). No correlation was found between the modified Rowe score and the nature of the associated lesions, sports activity or the VAS score.

At time of final follow-up, 3 of 12 athletes (25%) had returned to their pre-injury level of competition, 3 (25%) played at a lower level and 6 (50%)

Table II. — Questionnaire used to assess sports activities and satisfaction

What is your current level of sport ?
Would you undergo the operation again ?
Did you undergo surgery on your shoulder after the initial procedure ?
Are you satisfied with the result of the surgery ?

had stopped because of their shoulder pain. Nine athletes (75%) would choose to have the surgery again, 3 (25%) were not satisfied with the final outcome, and regretted having the surgery done. None of the 12 athletes underwent revision surgery or planned to have secondary surgery done.

DISCUSSION

Although initial reports showed a relatively low complication rate following thermal capsulorrhaphy, axillary nerve injury, recurrent dislocation, capsular obliteration, adhesive capsulitis and chondrolysis (*1,2,6,10,16,22,23,26*) are known complications. Thermal shrinking of joint capsular tissue is based on the changes in ultrastructural characteristics of collagen, leading to a macroscopic shortening of collagen fibers and thus shrinking of the tissue itself (*12,20*).

At the start of our study, it was believed that occult static or subtle dynamic anterior instability contributed to the aetiology of internal impingement (*14*) and initial clinical results of addressing the anterior laxity showed good to excellent results in the majority of athletes (*17,18*). While debridement of rotator cuff and labral pathology alone showed a tendency to deteriorate over time, this did not seem to be the case with adjuvant thermal shrinkage of the anterior capsule (*3,17,21*). However, to our knowledge there are no studies available that report on the long-term effects of this procedure regarding patient's satisfaction and return to sports.

Our data show excellent 1- and 2-year results regarding to the modified Rowe score, return to pre-injury competition level and patient satisfaction when thermal capsulorrhaphy is added to the standard treatment of rotator cuff and/or labral lesions. These results are comparable to those previously published (*17*). Unfortunately these results were not sustained over time and the 7-year follow-up results show a marked worsening of the modified Rowe score, with only 25% of our population still performing at their pre-injury level.

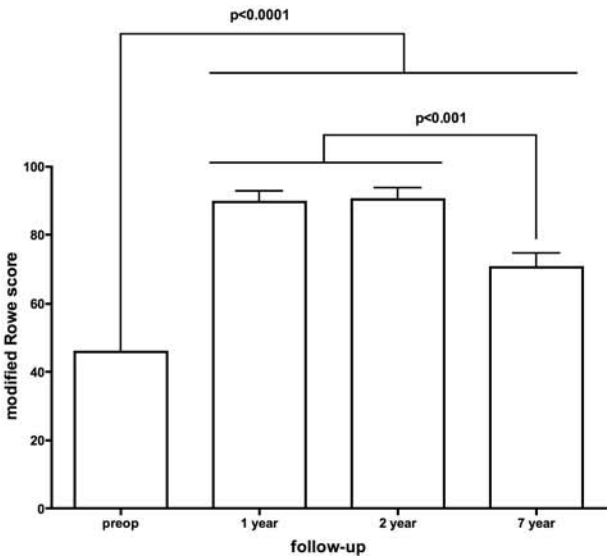

Fig. 2. — Statistical analysis showed a significant difference between the preoperative and the postoperative results ($p < 0.0001$). Although no difference was found between the 1- and 2-year results, the results were significantly worse at 7 years postoperatively ($p < 0.001$).

Burkhart *et al* (*5*) assembled a unified concept in which the contracted posteroinferior capsule initiated the pathological cascade in internal impingement. This leads to a posterosuperior shift of the humeral head and a pseudolaxity of the anterior capsule. The created shear forces lead to a "peel-back" and posterosuperior labral tearing (*4,19*). Excessive torsion of the rotator cuff may contribute to tearing of the articular surface fibers. The break in the ring of the posterosuperior labrum adds to the anterior capsular pseudolaxity and may manifest as a "drive-through" sign during arthroscopy (*5*). These authors therefore advocate repair of the labral lesion with an anchor to neutralize torsional peel-back, thus eliminating the pseudolaxity (*4*). We now routinely fix the posterosuperior labrum in athletes with internal impingement. In this manner the pathology may be better addressed but this cannot be concluded from the present study.

Our study confirms the good short-time results for thermal capsulorrhaphy in athletes with internal impingement, but there is a marked deterioration of the results over time. We cannot exclude that anteroinferior capsular laxity plays a role in the pathophysiology of internal impingement, but our study does not support the concept that treating this laxity by thermal capsular shrinkage will provide satisfying long-term results. Because there is still some doubt about the primary cause of internal impingement, it would be interesting to compare the results of capsulorrhaphy and repair of the posterosuperior labrum.

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