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Arthroscopic Complete Capsular Release for the Treatment of Frozen Shoulder

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Abstract：Frozen shoulder is characterized by spontaneous onset of shoulder pain accompanied by progressive stiffness and disability. It is usually self-limiting but often has a prolonged course over two to three years. Arthroscopic surgery has been used since 1990 to treat patients with frozen shoulder who failed to respond to conservative methods. A total of 27 consecutive patients with primary frozen shoulder who had failed to improve with conservative treatment for at least 3 months underwent 360 degree arthroscopic capsular release. A posteroinferior portal was established using a step cannulation system to avoid axillary nerve injury. The mean JOA pain score improved from 8.5±5.2 points to 23.1±4.1 points. The mean JOA ADL score improved from 4.1±1.7 points to 9.4±0.8 points. All range-of-motion values improved statistically from the immediate preoperative to the final postoperative state. Arthroscopic 360 degree arthroscopic capsular release provides the surgeon with the ability to divide the shoulder capsule under direct vision with greater control, and it is also an excellent treatment option for patients with frozen shoulder which has proven resistant to conservative management.

Key words：**Frozen shoulder, Arthroscopy, Treatment, Stiffness, Release**

Introduction

Frozen shoulder is characterized by the spontaneous onset of shoulder pain accompanied by progressive stiffness and disability. The causes of frozen shoulder still remain unclear ; however, the process involves thickening and contracture of the capsule surrounding the shoulder joint. It is usually self-limiting but often has a prolonged course over two to three years.[1)–3)] Surgical intervention may be necessary when conservative treatments, including the standard protocol of anti-inflammatory drugs or physical therapy, are not effective. Arthroscopic surgery has been applied since 1990 to treat patients with frozen shoulder who failed to respond to conservative methods.[4)] The initial arthroscopic procedure involved puncturing the coracohumeral ligament repeatedly with a needle or sectioning the coracohumeral ligament with electrocautery, and applying a manipulation under anesthesia.[4)] Subsequently, the procedure has evolved from arthroscopic anterior capsular release[5)] to 360 degree arthroscopic capsular release as described by Jerosch in 2001.[6)7)] The purpose of this study was to evaluate the clinical outcomes of 360 degree arthroscopic capsular release for refractory frozen shoulders.

Materials and Methods

In the period from 2004 to 2006, a total of 27 consecutive patients with primary frozen shoulder who had failed to improve with conservative treat-

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ment for at least 3 months underwent 360 degree arthroscopic capsular release. Of the 27 patients, 11 were male and 16 female, and their mean age was 53.1 years (range, 35–69 years) at the time of surgery. The average follow-up was 20.8 months (range, 12 to 32 months). The diagnosis of frozen shoulder was based on the clinical presentation. All patients presented with some limitations of shoulder motion (both passive and active ; elevation <120 degree, external rotation <30 degree), pain, functional limitations, and sleep disturbance. Any patient with a history or clinical evidence of shoulder arthrosis, cervical radiculopathy, peripheral neuropathy, calcific tendinitis, malunited fractures, previous shoulder arthroplasty, or previous instability surgery was excluded from this study.

Surgical procedure (**Figure 1**)

An epidural catheter was introduced with the standard loss of resistance technique at the C7–T1 space and inserted up to the level of C5. Then, the patient was placed in the beach-chair position under general anesthesia. An examination under anesthesia confirmed the restriction of shoulder motion, and the range of motion was recorded.

Step 1 anterior and superior capsular release

The arthroscope was inserted into the posterior portal, and the joint was inspected. After establishing an anterior portal in an inside-to-outside fashion, the anterior aspect of the capsule release started from the anterior to the long head of the biceps tendon. It was then performed down to the inferior edge of the glenoid with a VAPR Ⅱ plus 90° hook Electrode (Mitek, Westwood, MA). Again the adjacent superior capsule was released via the anterior portal.

Step 2 inferior capsular release

Access to the inferior aspect of the glenohumeral joint is crucial during arthroscopic shoulder procedures, especially in tight shoulders. A step cannulation system, consisting of a set of six obturators with increasing diameters was used to safety and

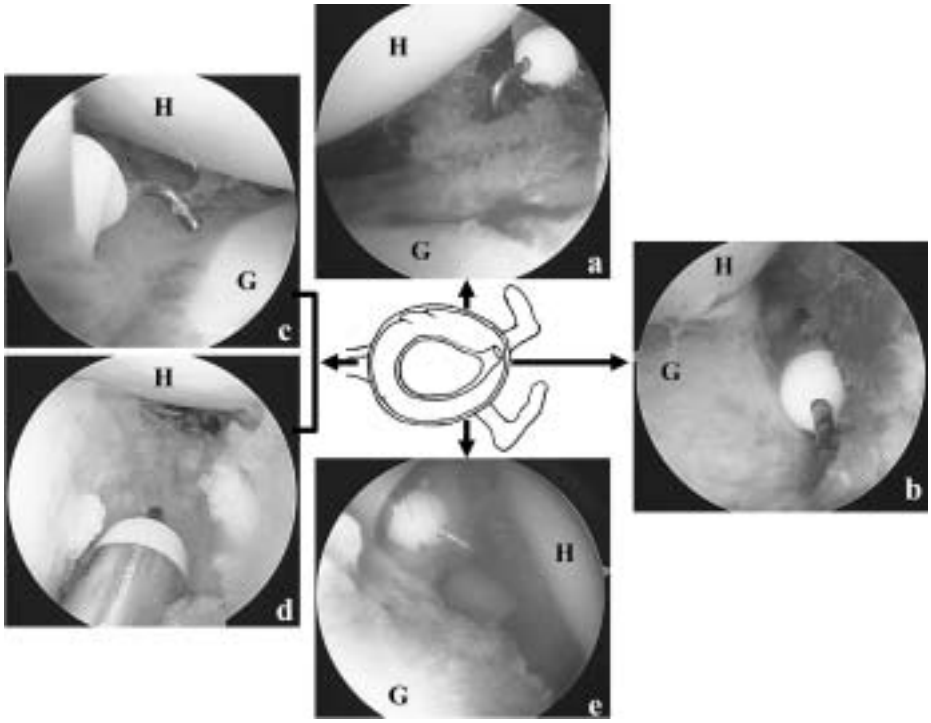

Figure 1 The three steps for 360 degree arthroscopic capsular release using the VAPR. Step 1 (a, b) : release of the anterior and superior capsule via an anterior portal ; Step 2 (c, d) : release of the inferior capsule via a posteroinferior portal established using the step cannulation system ; Step 3 (e) : release of the posterior capsule via a posterior portal. H : humeral head, G : glenoid rim

easily establish postero-inferior portal.[8] Care should be taken to protect the axillary nerve during the release of the entire axillary pouch.

Step 3 posterior capsular release

The posterior capsular release was performed with the arthroscope placed through an anterior portal in order to visualize the posterior portion of the glenohumeral joint. The incision was again made adjacent to the glenoid rim and started just posterior to the biceps tendon. The posterior aspect of the capsule was cut parallel to the glenoid rim about 5 mm from the dorsal labrum. The postoperative range of motion was measured after arthroscopy. No additional manipulation was thereafter performed.[7]

Postoperative rehabilitation

The rehabilitation program was initiated on postoperative days 1 or 2 with passive range-of-motion and pendulum exercises. Disposable, non-mechanical pumps were used for epidural infusions to achieve optimal postoperative pain control, Thereafter, either a 50 mg diclofenac sodium suppository (analgesic suppository) or a 15 mg pentazocine intramuscular injection (analgesic injection) was administered on request to the patients if they experienced any pain postoperatively.

Clinical evaluations

The patients underwent a standard history and physical examination. The nursing flow sheets were also reviewed to determine the dose, routes, and the number of times analgesic medications were administered postoperatively. Functional evaluations were made according to the Japan Orthopaedic Association (JOA) scores, which consist of four measures : 30 points for pain, 20 points for function, 30 points for range of motion, and 20 points for radiographic findings and stability.

Statistical analysis

The statistical analysis was performed by using paired *t*-test. A P value of less than 0.05 was considered to indicate a significant difference.

Results

The mean duration of follow-up for the 27 patients who had 360 degree arthroscopic capsular release was 20.8 months (range, 12-32 months). The mean duration of postoperative hospitalization was 21.1±9.8 days. Postoperative pain management by continuous cervical epidural analgesia was maintained for an average of 13.1±8.0 days. There were no symptoms of either infection or local anesthetic toxicity. The use of an analgesic suppository and an analgesic injection were 5.0±6.2 times and 1.2±3.4 times, respectively. The mean JOA shoulder score improved from 50.5±10.3 points preoperatively to 88.0±8.5 points postoperatively. The mean JOA pain score improved from 8.5±5.2 points to 23.1±4.1 points. The mean JOA ADL score improved from 4.1±1.7 points to 9.4±0.8 points. The mean JOA muscle strength score improved from 5.4±2.7 points to 9.6±0.8 points. All of these improvements were significant ($p<0.05$; Figure 2). All range-of-motion values improved statistically from the immediate preoperative to the final postoperative state. Overall, forward elevation improved from 73.7±16.9° to 155.2±10.7° ; external rotation improved from 13.3±17.5° to 55.7 ±10.0°, and internal rotation improved a mean of 6.9 spinous-process levels (range, three to eleven levels ; Figure 3). No minor or major complications, such as infection, iatrogenic fracture or dislocation, neurovascular injury were observed.

Discussion

Frozen shoulder is characterized by pain and a loss of motion or stiffness in the shoulder. It is usually self-limiting but often has a prolonged course of over two to three years. In a prospective study of 41 patients presenting with frozen shoulder who were followed for 5-10 years, Reeves demonstrated that 39% had full recovery, 54% had clinical limitation without functional disability and 7% had functional limitation.[1] Shaffer followed 62 patients with frozen shoulder for a mean of 7 years. Fifty percent of the patients reported shoulder pain or stiffness, or both, at their final evaluation. Intensive physical therapy, mobiliza-

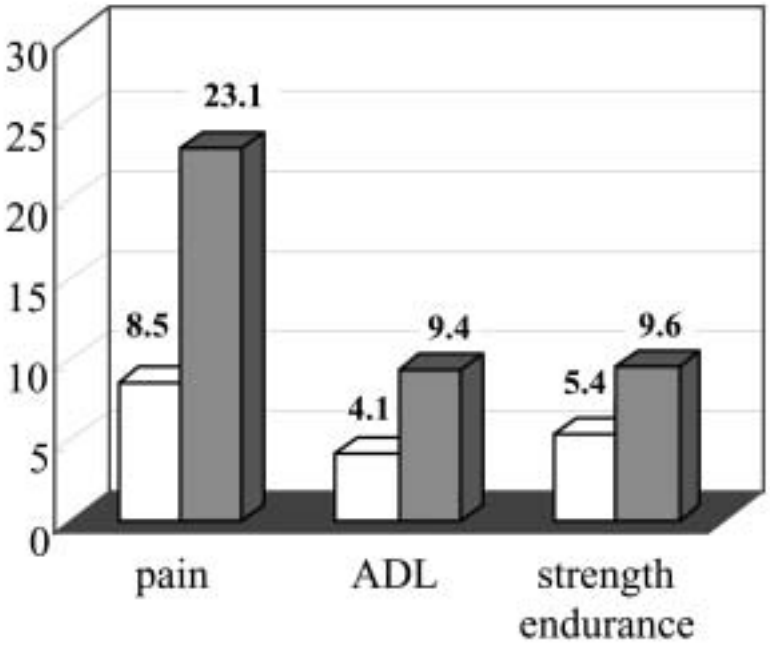

Figure 2 Graphs comparing pre- and postoperative JOA pain, ADL, strength endurance scores.

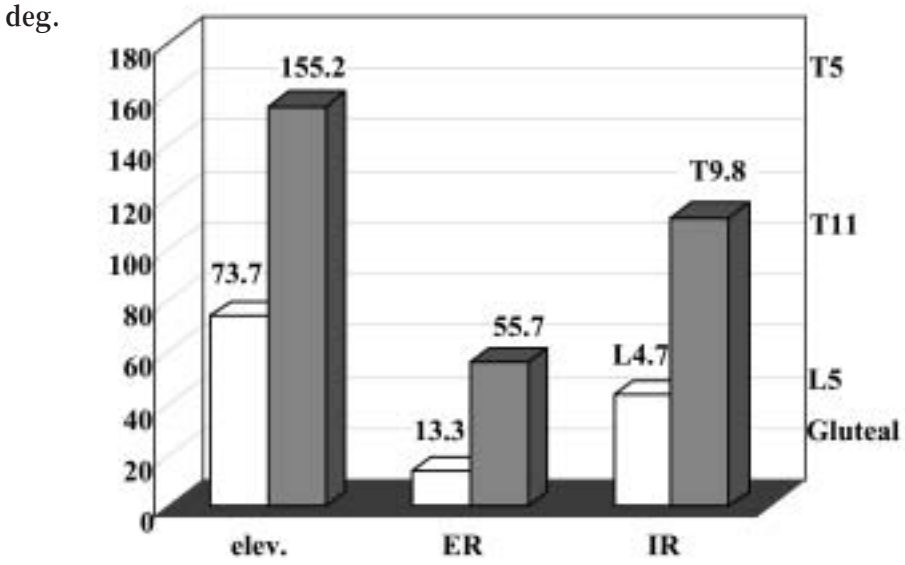

Figure 3 Graphs comparing pre- and postoperative ROM of the shoulder.
elev. : forward elevation, ER : external rotation, IR : internal rotation.

tion and stretching, intra-articular injections, distension arthrography have been performed with good results. However, these long periods of pain and disability suggest that more effective intervention approaches are therefore still needed.[2)]

Manipulation under anesthesia (MUA) for frozen shoulder may be an effective way of shortening the course of this apparently self-limiting disease and should be considered when conservative treatment fails. Even though MUA is effective in terms of joint mobilization, the blind method of disrupting the shoulder capsule can cause iatrogenic extraarticular or intraarticular damage, such as fractures, dislocations, brachial plexus injury, joint hemorrhage, and the labrum or subscapularis tendon injury.[9)] Fifty-four patients with frozen

shoulder were treated with MUA between 1980 and 1989. Thirty-five percent of the patients needed further surgery the initial treatment failed to restore motion to the shoulder.[10] Pap reported on 39 patients with frozen shoulder treated with MUA followed for an average of 3.4 years. A residual limitation in the range of motion was observed in 20% of all cases and the overall failure rate was 10%.[11]

Arthroscopic capsular release was first used in the mid-1980s because the outcomes of MUA could be quite variable and could even depend on the technique.[12] In the 1990s, multiple punctures made in the coracohumeral ligament with a needle or the coracohumeral ligament was sectioned with electrocautery, in addition to MUA to treat frozen shoulder in those who failed to respond to conservative methods. Subsequently, the procedure has evolved from arthroscopic anterior capsular release to anterior, superior and posterior capsular release (270 degree arthroscopic capsular release).[5] Berghs reviewed 25 patients with primary frozen shoulder who underwent arthroscopic capsular release. They did not release the inferior capsule arthroscopically, with a manipulation to avoid injuring the axillary nerve.[13] MUA was used to provide a minor detachment after 270 degree arthroscopic capsular release, rather than the sudden snap or release felt during traditional manipulations. However, arthroscopy performed immediately after MUA is associated with intra-articular hemarthrosis, avulsion of the inferior capsule peripheral to the labrum. Such extensive damage may explain the sometimes poor results seen with MUA after 270 degree arthroscopic capsular release.

A 360 degree arthroscopic capsular release has been applied since 2004 to minimize the soft tissue damage due to MUA.[7] Harryman first described a complete arthroscopic release of a chronic refractory capsular contracture of the shoulder in 1996.[14] A significant improvement in the range of motion is achieved after 360 degree arthroscopic capsular release, while the axillary nerve is at greatest risk during dissection the inferior capsule.[15][16] The axillary nerve is closest to the glenohumeral joint capsule between the 5 and 7 o'clock positions. The posterior-inferior portal needs to allow better access to the inferior glenoid rim and inferior capsule. Great care should be taken to avoid injury to the axillary nerve when the posterior-inferior portal is created.[12][14] The posterior-inferior portal is placed by an outside-to-inside technique. In general, after having confirmed a course with a spinal needle, a 4.5-mm cannula is re-introduced along the direction of the spinal needle. However, it is difficult to re-introduce such a large cannula to thickened inferior capsule with contracture while controlling the accurate direction.

A step cannulation system was used to insert an instrument into the contracted axillary recess safely and easily.[8] In this system, the capsule is pierced with a thin guide wire and increasingly larger guidewires were inserted step by step to establish a working portal. The incision of the joint capsule should be at the glenoidal insertion in the abducted and external rotated shoulder to minimize the risk of an axillary nerve injury, as described by Jerosch.[6]

The inferior capsule limits abduction as well as internal and external rotation to a certain degree.[15][16] Precise release of the inferior capsule may contribute to improvement of the range of motion. Glenohumeral elevation, rotation, and translation do not suddenly increase to allow the humeral head to move upon the glenoid in a dissociated manner, even after complete capsular release. The humerus head remains limited by the coracoacromial arch, glenoid labrum, and humeral tuberosities, and passive tension in the rotator cuff.[14][15][17]

Patients can initiate physical therapy immediate after surgery because a 360 degree arthroscopic capsular release is a less invasive procedure in comparison to an MUA. The current study showed significant increases in the motion and JOA shoulder score ($p<0.05$) after arthroscopic 360 degree arthroscopic capsular release. This procedure improves postoperative care by reducing the use of analgesic medications and reducing hospitalization. MUA was associated with complications, such as joint hemorrhage, rotator cuff tears, fractures, dislocations, brachial plexus injury. In contrast to an MUA, arthroscopic 360 degree arthroscopic capsular release provides the surgeon with the ability to divide the shoulder capsule under direct vision

with greater control. Therefore, 360 degree arthroscopic capsular release is considered to be an excellent treatment option for patients with frozen shoulder resistant to conservative management.

Conclusion

The performance of 360 degree arthroscopic capsular release is therefore considered to be a safe and effective tool in the management of refractory shoulder stiffness. However, it is essential to incorporate a strengthening and stretching exercise routine as soon as possible after performing such surgery.

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