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ORIGINAL STUDY

Frozen Shoulder – Comparison of different surgical treatment options

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In this study data from 54 patients with persisting primary frozen shoulder were collected and evaluated retrospectively. All included patients underwent a specific kind of surgical treatment of the shoulder. Three different surgical techniques were compared to each other. A group of 21 patients received a combination of arthroscopic capsular release and subacromial decompression. 18 patients were treated by subacromial decompression combined with mobilization under anesthesia and 15 patients underwent selective arthroscopic capsular release. We evaluated glenohumeral range of motion in every patient pre-and postoperatively. The investigated directions of motion were abduction, flexion and external rotation. The collected results were compared statistically. The mean follow-up of the treated patients was 37 weeks (range 11-52 weeks). All three surgical treatments improved the range of movement in every glenohumeral direction significantly. They achieved equal improvements in abduction and flexion. Regarding external rotation selective arthroscopic capsular release revealed not significantly better results than the other two surgical treatments, but there was a trend towards significance (p-value 0.0694). This study showed that all performed surgical techniques improved ranges of movement in the glenohumeral joint in patients with persistent frozen shoulder. Arthroscopic capsular release, alone or with subacromial decompression, is a safe procedure and showed the best results postoperatively. In our opinion arthroscopic capsular release should be recommended as the first choice treatment in persistent frozen shoulder.

INTRODUCTION

Frozen Shoulder is a restriction of both, active and passive glenohumeral movement, accompanied by shoulder pain (*17*). The mostly impaired directions of motion are flexion, abduction and external rotation (*15*). The frozen shoulder affects about 2 to 4 % of the population (*10*). The majority of the patients are between 40 to 60 years of age (*19*). Females are more often affected than males (*3*). There are two different forms of the frozen shoulder, the primary and the secondary. The primary frozen shoulder occurs spontaneously, whereas the secondary frozen shoulder is a consequence of trauma or immobilization (*1*). In 1934 Codman stated, that the frozen shoulder is a self-limiting disease, restoring in about two years (*2*). However other studies postulated that the frozen shoulder can persist over a longer period of time, or become even chronic. In a study by Shaffer *et al* (1992)

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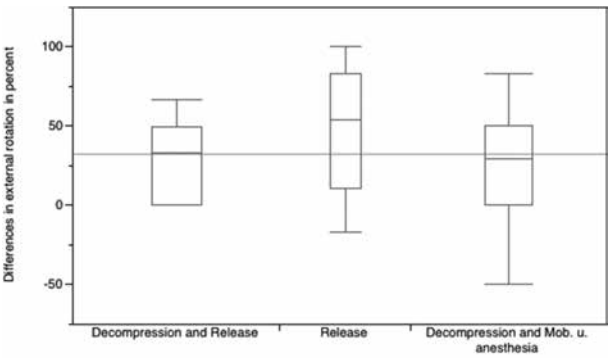

Fig. 1. — Differences in external rotation : Comparison of the three treatment groups.

62 patients with frozen shoulder were investigated. The patients were all treated with physiotherapy supplemented by various conservative treatment procedures including use of a transcutaneous electrical nerve-stimulator unit, ultrasound or massage (73%), subacromial injection of lidocaine and cortisone (84%) and the use of non-steroidal anti-inflammatory drugs (53%). Ten patients were treated with manipulation under anesthesia. 50% of the patients had persisting pain or stiffness of the shoulder or both after a mean follow-up of seven years (*16*). A study by Hand *et al* (2008) confirmed these findings. They evaluated 223 patients with frozen shoulder with a mean follow-up of 4.4 years. Patients underwent different modalities of treatment including physiotherapy, steroid injections, manipulation under anesthesia (MUA), MUA and arthroscopic release or MUA and arthroscopic hydrodistension. 95 of the patients did not have a treatment at all. 41% of the 223 patients had persisting symptoms, although the majority of them were mild (*9*).

Due to the fact that the frozen shoulder is a very painful and disabling disease, an appropriate therapy is of particular importance. Conservative treatment is usually the primary type of treatment. Regarding this there are several treatment options, including physiotherapy, non-steroidal anti-inflammatory medication, corticosteroids and electrical stimulation (*19*). If conservative treatment fails, surgical interventions can be considered. Passive mobilization under anesthesia with or without subacromial decompression is one option. Two studies revealed good results for that procedure *(4,6)*. However a study by Kivimäki *et al* (2007) compared passive mobilization to home exercise therapy and found no additional effect (*12*). Another surgical technique is the arthroscopic capsular release. As shown in several studies, it is a secure and effective therapy in persistent frozen shoulder (*10*). To our knowledge comparison of these different invasive treatment techniques does not exist in the literature. Because frozen shoulder can be a persisting disease, standardized surgical therapy is of particular importance. Thus comparison between surgical therapy options seems to be very useful. Therefore we compared three common surgical interventions. We evaluated ranges of glenohumeral movement of 54 patients with persisting primary frozen shoulder before and after surgical treatment.

MATERIALS AND METHODS

In this study data from 54 patients with persistent primary frozen shoulder were evaluated retrospectively. The data were collected at the University Hospital of Basel. Patients with frozen shoulder who first underwent at least six months of ineffective conservative treatment were included. The study population consisted of 29 female and 25 male. The ages ranged from 27 years to 75 years. The mean age at surgery was 52 years. All patients suffered from primary frozen shoulder. Six patients with hyper-or hypothyroidism and 9 patients with diabetes were included. The ranges of motion before surgery were collected in every patient. Statistical analysis revealed that the differences in preoperative mobility between the groups were not confounding. Table I shows the characteristics of the 54 patients.

In the course of conservative therapy all patients received physiotherapy for at least 6 months and maximally for 8 months. 30 of the patients also had steroid injections and 19 used non-steroidal anti-inflammatory drugs. None of the patients had concomitant shoulder pathologies as impingement syndrome or rotator cuff tears. Patient characteristics and group distribution is explicitly shown in the next chapter (Table I). Surgeries were made between 1992 and 2010. The mean follow-up after surgery was 37 weeks (range 11-52 weeks). Patient data were collected by orthopedic specialists exclusively. Ranges of motion were assessed by using a goniometer and were documented with neutral-0 method. Thereby range of motion in a specific direction was indi-

Table I. — Patient characteristics

	Decompression and release	Release	Decompression and Mobilization under anesthesia
Number of patients	21	15	18
Ratio female to male	13:8	10:5	6:12
Hypo- or hyperthyroidism	3	1	2
Diabetes mellitus	3	4	2
Mean age at surgery	53	52	50
Mean abduction in % before surgery	42% (75.6°)	36% (64.8°)	40% (72°)
Mean flexion before surgery	49% (83.3°)	45% (76.5°)	48% (81.6°)
Mean external rotation in % before surgery	34% (20.4°)	14% (8.4°)	28% (16.8°)
Mean follow-up	28 weeks	42 weeks	32 weeks

cated as the maximal deflection from the neutral position in angular degrees, whereas the neutral position was defined by 0°. Three different surgical techniques were used. 21 patients received a combination of arthroscopic capsular release and arthroscopic subacromial decompression. 15 patients underwent selective arthroscopic capsular release and 18 patients were treated by arthroscopic subacromial decompression combined with mobilization under anesthesia. The orthopedic surgeons decided which treatment each patient would get. Ranges of motion of the glenohumeral joint were measured in every patient and converted into percent. In flexion 100% equate 170°, in abduction 100% equate 180° and in external rotation 100% equate 60°. The average of the percentage quotation in these movement directions of each group was evaluated. Statistical analysis was done by the two-way Student t test (improvement within the treatment groups) and the Tukey-Kamer HSD (comparison between the groups).

Surgical technique

Selective arthroscopic release : by a posterior arthroscopic portal the camera was positioned between the biceps tendon and the head of the humerus. The electro resector was inserted right above the subscapularis tendon. Fibrosed tissue in the rotator interval was vaporised. In the further procedure the anterior, pobterior, and inferior capsule was released right next to the labrum glenoidale.

Selective arthroscopic release and decompression : after the selective arthroscopic release subacromial decompression was done. The arthroscope was inserted from posterior into the subacromial space. The instruments were inserted from an anterolateral portal. First adhesions were resected. Then the coracoacromial ligament was released and the antero-lateral part of the acromion was removed.

Mobilization under anesthesia and decompression. The extremity was elevated in sagittal plane until a creaking sound was heard. This was followed by abduction on shoulder height while performing a slight internal rotation force to release the posterior capsule. The arm was then adducted while perfoming an external rotation. External rotation was then made with the elbow inflected to release the ligg. coracohumerale and glenohumerale superior. This procedure was followed by decompression.

RESULTS

Postoperative improvement

Decompression and Capsular Release : 20 of 21 patients improved their ranges of movement after surgery by subacromial decompression and capsular release. Mean abduction changed from 42% to 77%, this was a significant difference of 35% (level of significance = 0.001). Mean flexion improved from 49% to 86%, which was a significant increase of 37% (level of significance = 0.001). Concerning mean external rotation an improvement from 34% to 62% was achieved, which was a significant gain of 28% (level of significance = 0.001).

Table II. — Pre- and postoperative mean values of ranges of movement of the three treatment groups

	Decompression and Release		Release		Decompression and Mobilization under anesthesia	
	Pre OP	Post OP	Pre OP	Post OP	Pre OP	Post OP
Abduction	42% (76°)	77% (139°)	36% (65°)	72% (130°)	40% (72°)	69% (124°)
Flexion	49% (83°)	86% (146°)	45% (77°)	80% (82°)	84% (82°)	81% (138°)
External rotation	34% (20°)	62% (37°)	14% (8°)	65% (39°)	28% (17°)	51% (31°)

Capsular Release : 14 of 15 patients in this group achieved an improvement of their ranges of movement. Concerning abduction, ranges of movement changed from 36% to 72%, which was a significant difference of 36% (level of significance = 0.001). In flexion the mean values improved from 45% to 80%, which was a significant increase of 35% (level of significance = 0.001). Mean external rotation changed from 14% to 65%, this was a significant improvement of 51% (level of significance = 0.01).

Decompression and mobilization under anesthesia : all patients could improve their ranges of movement after surgery by arthroscopic subacromial decompression and mobilization under anesthesia. Mean abduction changed from 40% to 69%, which was a significant improvement of 29% (level of significance = 0.001). Mean flexion changed from 48% to 81%, the significant improvement was 33% (level of significance = 0.001). Mean external rotation improved from 28% to 51%, this corresponds to a significant gain of 23% (level of significance = 0.01).

Comparison of the surgical techniques

All groups made an improvement in ranges of motion in all investigated directions of movement after surgery.

Concerning abduction arthroscopic capsular release led to the best postoperative results with an improvement of range of motion of 36%. However, there were no statistically significant differences between the groups. Concerning flexion subacromial decompression combined with capsular release was superior to the three other treatments with an improvement of ranges of motion of 37%. The differences in ranges of motion between the groups were not significant. Concerning external rotation capsular release revealed the best results with a gain of 51% in ranges of motion. The difference between capsular release and decompression combined with mobilization under anesthesia showed a trend towards significance (p-value 0.0694). The other differences between the surgical techniques were not significant.

DISCUSSION

This study demonstrated that all performed surgical techniques (decompression and mobilization under anesthesia, decompression and release and release alone) improved ranges of movement in the glenohumeral joint in patients with persistent frozen shoulder. The mean follow-up of all procedures ranged from 11 weeks to 52 weeks and achieved therefore good results in short and middle term outcome. Only 3 of the 54 patients (5.6%) showed no improvement of ranges of motion postoperatively and did not profit from surgical treatment. These findings are consistent with the studies of Chambler and Carr (2003). They reviewed several studies and found a benefit of surgical treatment in persistent frozen shoulder (*2*). Arthroscopic capsular release with or without subacromial decompression and mobilization under anesthesia combined with subacromial decompression revealed almost equal results in improvement of glenohumeral function. However, arthroscopic capsular release, alone or with subacromial decompression, showed the best results in every evaluated direction of motion postoperatively. Additionally this surgi-

cal procedure generated an almost significant higher improvement of external rotation compared to decompression combined with mobilization under anesthesia. Whether arthroscopic capsular release should be preferred principally as a surgical treatment in persistent frozen shoulder could not be determined in this study. Future prospective studies have to answer this question. In our opinion this is a question with an important clinical consequence. Furthermore patient safety is a keystone in any treatment planning. Possible complications of arthroscopic capsular release are wound healing disorders, infections, thrombosis, instability and dislocation or nerve lesions (*11*). On the other hand capsular release has been proven as a treatment with little risks (*10*). In a study of Jerosch *et al* (2012) 173 shoulders were treated with arthroscopic capsular release. In only one case a relevant complication was reported (*11*). In another study by Le Lievre and Murrell (2012) arthroscopic capsular release was performed in 49 shoulders (43 patients). No intraoperative, postoperative or long-term complications occurred (*13*). Glenohumeral manipulation under anesthesia can lead to severe complications as well. Rotator cuff tears, surgical neck and humeral shaft fractures, dislocations and complete brachial plexus palsy are reported in the literature (*7*). In a prospective study of Loew *et al* (2005) 30 patients underwent glenohumeral manipulation under general anesthesia. The shoulder joints were examined by arthroscopy subsequently. Haemarthrosis was found in all patients after manipulation under general anesthesia. A rupture of the superior capsule was detected in 11 patients, a rupture of the anterior capsule up to the infraglenoid pole was verified in 24 patients and a posterior capsular lesion was found in 16 patients. Furthermore 3 acute partial tears of the subscapularis tendon, 4 anterior labral detachments and 2 tears of the middle glenohumeral ligament were detected (*14*). Therefore, arthroscopic capsular release seems to be a more surgeon controlled treatment for frozen shoulder than mobilization under anesthesia. Due to this fact in our opinion arthroscopic capsular release should be recommended as the first choice surgical treatment in persistent frozen shoulder even now. Several studies evaluated results of conservative therapy (*5*,*8*) and no treatment strategy (*18*) in patients with Frozen Shoulder. In a study by Griggs *et al* (2000) 77 shoulders with idiopathic adhesive capsulitis were examined. The patients were treated with a stretching-exercise program. The mean follow-up was twenty-two months (1.8 years). Active forward elevation improved 43 degrees and active external rotation improved 25 degrees in average *(8)*. Compared to our study with absolute values in glenohumeral motion of all patients, forward elevation increased 55 degrees and external rotation increased 17 degrees in average. That would mean there is no distinct advantage of surgical treatment. Additionally two other studies, one of Dudkiewicz *et al.* (2004) and another one by Vastamäki *et al.* (2011) showed almost equal results as in our study with conservative treatment regime, but with a longer mean follow-up (*5*,*18*). However, the question if the symptoms of the frozen shoulder will disappear faster with surgical treatment still remains.

We acknowledge that there are some limitations of our study. The study is retrospective, so there was no randomization or blinding possible. The ranges of movement of the affected shoulders were compared to a fictional full range of movement and not to the ranges of movement of the contralateral shoulders. Additionally there was no matched control group without any surgical treatment.

CONCLUSIONS

This study showed that all performed surgical techniques improved ranges of movement in the glenohumeral joint in patients with persistent frozen shoulder. Arthroscopic capsular release, alone or with subacromial decompression, is a safe procedure and showed the best results postoperatively. In our opinion arthroscopic capsular release should be recommended as the first choice treatment in persistent frozen shoulder after failed non-operative therapy.

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