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ORIGINAL STUDY

Results of Arthroscopic Capsular Release for Treatment of Frozen Shoulder

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Abstract

Objectives: **The aim of this study is to evaluate the functional outcome of arthroscopic capsular release for treatment of frozen shoulder.**

Background: **Frozen shoulder is a painful restriction of both active and passive glenohumeral movement. Most impaired directions of motion are flexion, abduction, and external rotation. Arthroscopic capsular release treatment of frozen shoulder was found to be safer than open surgical release and manipulation under general anesthesia as it is less probable to cause iatrogenic humeral fracture bone or the rotator cuff tear.**

Patients and methods: **A prospective study on 18 patients with frozen shoulder treated by arthroscopic capsular release.**

Results: **At the end of the follow up, the mean score of external rotation according to the Constant and Murley score was 7.4 ± 2.16, compared with a preoperative mean of 1.8 ± 1.11, the mean score of active forward flexion was 9.4 ± 0.94, compared with a preoperative mean of 4 ± 1.45, the mean score of active abduction was 8 ± 0.92, compared with a preoperative mean 3.1 ± 1.21, the mean score of strength was 17 ± 5.48, compared with a preoperative mean 10.5 ± 5.1. At the end of the follow up period, the mean final score was 80.72 ± 11.16 and all patients achieved excellent score postoperatively.**

Conclusion: **Arthroscopic capsular release is an effective and safe method for treatment of refractory cases of frozen shoulder in which other treatment methods failed. It achieved dramatic pain and motion improvement immediately postoperatively, allowing very early postoperative rehabilitation.**

Keywords: Arthroscopic, Capsular release, Frozen shoulder, Humerus bone, Rotator cuff

1. Introduction

Frozen shoulder is a painful restriction of both active and passive glenohumeral movement. The most impaired directions of motion are flexion, abduction, and external rotation [1]. In 1934, Codman [2] stated that the frozen shoulder is a self-limiting disease, restoring in about 2 years, however other studies show that the frozen shoulder can persist over a longer period of time, or even become chronic. In 1945, Neviaser [3] first used the term 'adhesive capsulitis' to describe a condition starting with shoulder pain then progresses to gradual restriction of movements of shoulder in all directions.

Approximately 5% of all adults suffer from this disease, with women, between the age of 40 and 60 years, being the majority of the patients. Commonly related risk factors include diabetes mellitus, prolonged shoulder immobilization and autoimmune diseases [4]. Adhesive capsulitis is primary when no certain etiology is clear, or secondary with causes being local to the shoulder joint as in prolonged immobilization following humerus fracture or general like hypothyroidism and diabetes mellitus [5]. Physiotherapy, analgesics for pain, local steroid injection, and manipulation can all be effective for frozen shoulder, it is reported recently that arthroscopic capsular release for frozen shoulder is effective and safe in several literatures [6].

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In 2014, Walther et al. [6] reported that it should be recommended as the early choice for treatment in persistent frozen shoulder.

The arthroscopic capsular release in treatment of frozen shoulder was found to be safer than open surgical release and manipulation under general anesthesia as it is less probable to cause injury of the humerus bone or the rotator cuff [7].

This study aimed to evaluate the functional outcome of arthroscopic capsular release for treatment of frozen shoulder.

2. Patients and methods

This prospective study included 18 patients with frozen shoulder treated by arthroscopic capsular release. The study was conducted at Menoufia University Hospitals and Elmogama Al Teby medical insurance hospital in Tanta.

Inclusion criteria were patient's age more than 18 years old of both sexes with history of shoulder pain and difficulty performing activities of daily living due to loss of range of motion for more than 1 month, frozen shoulder patient within the adhesive phase, severe night pain with no improvement of flexion and external rotation, failed conservative treatment for 3–6 months, limited passive shoulder motion of less than or equal to 90° of forward flexion, less than or equal to 20° of external rotation of the arm and hand behind back range of motion to the fifth lumbar vertebra or lower.

Exclusion criteria was patients with complete rotator cuff tear, acromioclavicular subluxation, radiographic evidence of abnormalities indicating glenohumeral osteoarthritis, calcific tendinitis, superiorly migrated humeral head, osteonecrosis of the humeral head, a history of fractures or surgery around the shoulder, posttraumatic frozen shoulder and neurovascular injury.

Informed consent was taken from all patients regarding information on the procedures and its possible complication. Approval was obtained from the ethical committee of scientific research of Faculty of Medicine, Menoufia University (under code no. 4/2021ORTH4).

All patients were evaluated by history taking including personal data, age, sex, time of trauma, level of activity, medical comorbidities, and previous intervention in relation to shoulder of interest.

General and local examination were done including skin condition, local assessment of trauma site for (hotness, edema, tenderness, or skin dimpling) neurovascular examination, range of motion: restriction of both active and passive shoulder range of motion (forward elevation <90° and external rotation <20°), scapula mobility and stability and cervical spine.

All patients were subjected to full investigations such as complete blood picture, fasting blood sugar, rheumatoid factor, T3, T4, bleeding time, clotting time, prothrombin time, blood urea and creatinine, liver enzyme, C-reactive protein.

All patients were investigated radiologically by radiograph anteroposterior and axillary lateral views of the affected shoulder and MRI (sagittal, axial, and coronal views) was done for every patient (Fig. 1). Every patient was informed about the pathology, the planned intervention, the schedule of follow up and weekly visits, postoperative rehabilitation protocol, and possible complications.

Operative technique started by single prophylactic antibiotic administered 2 h before the indicated surgery in the form of 1 g of intravenous third-generation cephalosporin injection then general anesthesia was administered for all patients.

All capsular attachments along the upper rolled edge of the subscapularis tendon were released, the subscapularis tendon were freed from behind and intra-articularly, release of middle glenohumeral ligament (MGHL) where it crossed the subscapularis tendon (Fig. 1).

After the patient transference to the operating table, a team-based approach was used to ensure that the patient was in the appropriate position before raising the back of the table up to the beach chair position, then several folded surgical towels were placed medial to the patient's scapula to improve the shoulder position, then a safety-belt and tape were applied to secure the patient to the table. After induction of anesthesia, an examination under anesthesia was carried out on the operated shoulder to assess the range of motion and stability in all directions. The anticipated portal sites were drawn out using bony landmarks, including the acromion, clavicle, acromioclavicular joint and coracoid process. After introducing a 4-mm arthroscopy through the standard posterior portal and performing an initial diagnostic arthroscopy (Fig. 2), an anterior portal was made just lateral to the coracoid process superior of the subscapularis tendon using the outside-in technique in order to facilitate maneuvers by instruments such as shavers and radiofrequency instrument. Assessment of the long head of the biceps adhered to the CH ligament over shoulder joint was done and elimination of any adhesion was done using a radiofrequency instrument. The joint capsule was removed just next to the labrum using a radiofrequency instrument and rasp from 5 o-clock to 11 o-clock of the right-side shoulder then release of the anterior and posterior

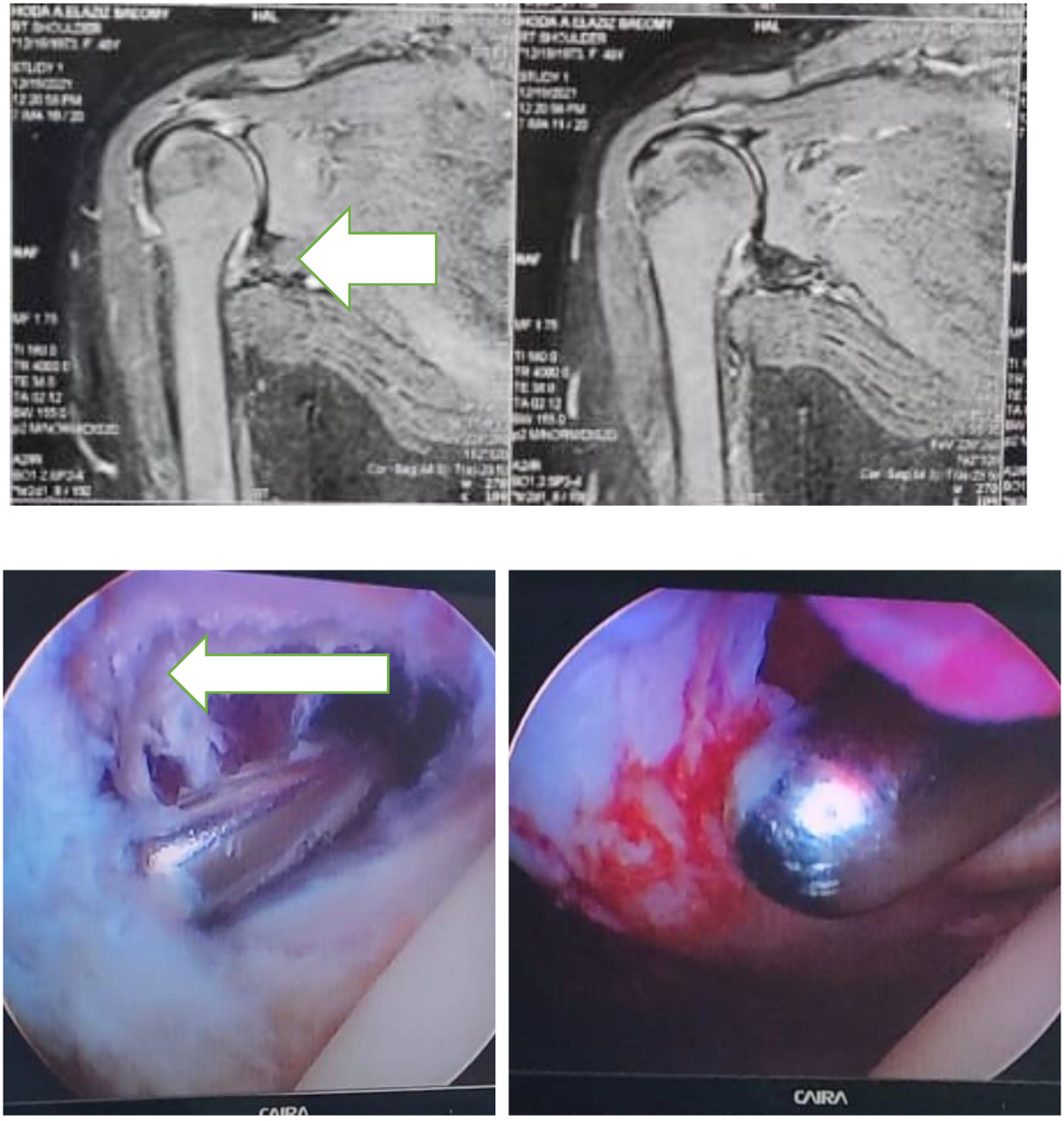

Fig. 1. MRI of a frozen shoulder of 40-year-old patient with white arrow pointing at an abnormally thickened inferior glenohumeral ligament and the axillary pouch is contracted and poorly distended and arthroscopic images of the affected site with white arrow pointing at adhesions of the capsule.

structures proceeded as follows: superior capsule was released above the glenoid rim along the upper edge of biceps tendon then release of the rotator interval was performed from the upper edge of the subscapularis tendon to the biceps tendon then releasing the capsule of the rotator interval and releasing the coracohumeral ligament (CHL), then the fleshy fibers of subscapularis were seen.

The scope was shifted to the anterior portal to perform posterior capsular release by introducing the radiofrequency ablation device through the posterior portal. Posterior release begins from the glenoid level down to the 6 o'clock position until the back fibers of the infraspinatus muscle appear. Then the hook-tip part of the radiofrequency ablation device is used to perform a transverse release in the posterior capsule, starting from the beginning of the longitudinal limb. The transverse limb was performed in a stepwise manner going step-by-step laterally but ending before reaching the rotator cuff to avoid any damage of the cuff. The range of external rotation was examined at variable degrees

Fig. 2. Arthroscopic view showing a normal rotator interval in comparison with rotator interval in a frozen shoulder marked by white arrow showing thickened and hyperemic synovium.

of abduction to check whether the degree of external rotation was equal to the opposite side or not. After arthroscopically observing the joint, the scope was moved into the subacromial space via the lateral portal, shaving the synovium in the subacromial bursa, and carefully observing the rotator cuff. Arthroscopic subacromial decompression was performed and subacromial bursa removed by using the rasp. The total operative time and the length of hospital stay were recorded.

Postoperative rehabilitation protocol consisted of passive, assisted-active exercises and stooping exercise were commenced for forward flexion and external rotation 1 day after surgery with the assistance of a physical therapist. After 2 weeks of passive exercise, the patients were instructed to start active exercise to strengthen the rotator cuff and scapular stabilizers. The rehabilitation was continued after surgery to obtain complete muscle strength of the shoulder and full range of motion (Fig. 3).

Patients were followed up in scheduled visits of 1, 2, 4, 12 weeks, and 6 months postoperatively, patients were assessed generally and ensured that the wound healing was okay without any complication.

All the patients were assessed with functional scoring system Constant and Murley score [8].

2.1. Statistical analysis

Data were collected, tabulated, and statistically analyzed using an IBM compatible personal computer with Statistical Package for the Social Sciences (SPSS), version 27 (IBM SPSS Statistics for Windows, Version 27.0; IBM Corp., Armonk, New York, USA). The methods used were: (a) quantitative data

Fig. 3. Patient regaining full ROM after 6 months postoperative. ROM, range of motion.

were described using range (minimum and maximum), mean and SD. (b) The *P* value (probability means likelihood) express the probability that a difference, as the one obtained by the study would occur by chance alone. If the *P* value is smaller than the significance level, this mean the difference is real. Usual levels used are 0.05 and 0.01, the lesser the *P*, the more significant. *P* value less than 0.01 is more significant than *P* value less than 0.05. So, *P* value (level of significances) less than 0.05 were considered significant, *P* value more than 0.05 insignificant. *P* value formula = total number of occurrence of events/total number of trials.

3. Results

In the study there were 18 patients aged from 39 to 68 years old, seven patients less than 50-year-old and 11 patients aged above 50-year old. Eleven out of 18 patients were females consisting more than 60% of the sample size. Ten out of 18 patients were housewives, four were heavy laborers, and four were office workers. The majority of cases had frozen shoulder in their dominant hand (78%) while the remaining 22% had the pathology in their nondominant hand. Twelve (66.7%) out of 18 of the patients were diabetic.

At the end of the follow up, the mean score of external rotation according to the Constant and Murley score was 7.4 ± 2.16 (range, 4–10). Compared with a preoperative mean score of 1.8 ± 1.11 (range, 0–4). At the end of the follow up period, the mean score of active forward flexion was 9.4 ± 0.94 (range, 8–10). Compared with a preoperative mean 4 ± 1.45 (range, 2–6) (Table 1).

At the end of the follow-up period, the mean score of active abduction was 8 ± 0.92 (range, 6–10). Compared with a preoperative mean 3.1 ± 1.21 (range, 2–6), also, by the end of the follow-up period, the mean score of strength was 17 ± 5.48 (range, 10–25). Compared with a preoperative mean 10.5 ± 5.1 (range, 5–20) (Table 2).

Table 1. Comparison between preoperative and postoperative range of motion (external rotation and forward flexion) (N = 18).

ROM (active combined external rotation)	Preoperative	Postoperative
Minimum–maximum	0–4	4–10
Mean ± SD	1.8 ± 1.11	7.4 ± 2.16
Z(*P*)	3.97[a] (0.000036)	
ROM (forward flexion)		
Minimum–maximum	2–6	8–10
Mean ± SD	4 ± 1.45	9.4 ± 0.94
Z(*P*)	3.983[a] (0.000034[a])	

ROM, range of motion; *Z*, Wilcoxon signed-ranks test.
P: *P* value for comparing between preoperative and postoperative.
[a] Statistically significant at *P* value less than or equal to 0.05.

The mean preoperative final score was 54.17 ± 10.74 (range, 30–70). At the end of the follow-up period, the mean score was 80.72 ± 11.16 (range, 60–96) (Table 3).

In the study patients aged less than 50 years had a greater improvement on the Constant and Murley score with score results increasing between 20 and 50, in comparison to patients older than 50 years whose score raised by 10–36. Although younger patients had greater increase in the final score results (20–50) in comparison to older patients (10–36), the level of patient satisfaction was almost the same. Both sexes showed almost equal improvement on the Constant and Murley score with males having mean increase of 25 and females having mean increase slightly higher of 27.5.

Ten patients had no complaints postoperatively; three patients complained of residual pain and limited range of motion that gradually got better with extensive physiotherapy by the end of follow-up period. Two patients complained of sense of instability despite that clinically the joint was stable and by the end of follow-up period patients were accustomed to new range of motion and no longer had that complaint. Two patients complained of paresthesia on the lateral aspect of the shoulder that slowly improved after neurotonics for 2–4 months and one patient had local superficial infection at sutures of two portal sites that was treated by daily dressing and antibiotics for 10 days and sutures were removed after wounds healing.

3.1. Case presentation

We had a male patient 40 years old, carpenter, complaining of left frozen shoulder for 9 months, he received NSAIDs for 6 months, he is noninsulin dependent diabetic. Arthroscopic capsular release was done, and he started shoulder stretching exercises first day postoperative and followed up for 6 months and was graded as excellent (Figs. 2 and 3).

4. Discussion

There is no consensus regarding the standard treatment protocol of frozen shoulder. The methods of treatment described in the literature for adhesive capsulitis are all aiming to improve stiffness and relieve pain. This symptomatic treatment of the condition helps to improve the lifestyle and the functional ability of the patient. However, treatment should be directed to deal with the causative factor, if this could be diagnosed. A number of treatment modalities had been described for the frozen

Table 2. Comparison between preoperative and postoperative range of motion and strength score (active abduction) (N = 18).

Variables	Abduction score	Preoperative	Postoperative
Preoperative and postoperative ROM	Minimum–maximum	2–6	6–10
	Mean ± SD	3.1 ± 1.21	8 ± 0.92
	Improvement	↑4.90 ± 1.37	
	Z(*P*)	4.008[a] (0.000031[a])	
Preoperative and postoperative strength score	Minimum–maximum	5–20	10–25
	Mean ± SD	10.5 ± 5.1	17 ± 5.48
	Improvement	↑6.5 ± 5.16	
	Z(*P*)	0.820[a] (0.000158[a])	

ROM, range of motion; Z, Wilcoxon signed-ranks test.
P: P value for comparing between preoperative and postoperative.
[a] Statistically significant at P value less than or equal to 0.05.

Table 3. Comparison between preoperative and postoperative final Constant–Murley) score.

Constant–Murley score	Preoperative	Postoperative	*Z*	*P*
Minimum–maximum	30–70	60–96	3.740*	0.000092*
Mean ± SD	54.17 ± 10.74	80.72 ± 11.16		
Improvement (increase)	26.55 ± 11.60			

Z, Wilcoxon signed-ranks test.

shoulder, starting by expectant observation and ending by operative surgical release [9].

In 1979, Conti [8] was the first who reported the use of arthroscopic equipment for partial surgical release of contracted articular capsule. The advantage of this method is that it allows performing controlled selective capsular releases.

The study included 18 cases of primary frozen shoulder that have been treated by arthroscopic capsular release.

The procedure in all patients treated was arthroscopic capsular release entails the release of the anterior capsule (including the rotator interval, MGHL), inferior and posterior capsule of the shoulder joint, release of the capsular adhesions around the intracapsular portion of the subscapularis muscle was done.

The radiofrequency ablation device was used in all of the release with special attention to avoid injuring the axillary nerve while releasing the inferior recess by putting the shoulder in abduction and external rotation; with this maneuver the nerve is in the farthest position from the inferior capsule as reported in anatomical study by Uno et al. [10].

In the study; at the end of follow-up period the mean Constant score improved from 54.17 ± 10.74 ranging from 30 to 70 points to 80.72 ± 11.16 ranging from 60 to 96 points postoperatively.

Three patients complained of residual pain and limited range of motion that gradually got better with extensive physiotherapy by the end of follow-up period, two patients complained of sense of instability despite that clinically the joint was stable and by the end of follow-up period patients were accustomed to new range of motion and no longer had that complaint, two patients complained of paresthesia on the lateral aspect of the shoulder that slowly improved after neurotonics for 2–4 months and one patient had local superficial infection at sutures of two portal sites that was treated by daily dressing and antibiotics for 10 days and sutures were removed after wound healing.

Smith et al. [11] reported that 50 and 80% of patients had good pain relief within 1 and 6 weeks of arthroscopic capsular release, respectively. On average, it takes 16 days to achieve good pain relief.

Le Lievre and Murrell [12] assessed the long-term results after arthroscopic capsular release for idiopathic frozen shoulder. They observed that all 43 patients had improvement in pain frequency and severity, shoulder function and range of motion at a long-term follow-up of 7 years. Poor results were more in females more than 50 years old and have type 2 diabetes mellitus. At 1 year, the recurrence can be up to 11% following arthroscopic capsular release.

Mubark et al. [13] evaluated the results of management of adhesive capsulitis using the arthroscopic capsular release. The mean Constant and Murley score was increased from 36.3 preoperatively to 85.8 after follow up. Twenty-two (55%) patients had excellent results, 14 (35%) patients had good results, four (10%) patients had fair results, and none had poor results.

Waszczykowski and Fabiś [14] found that the improvement in the range of motion after arthroscopic capsular release was statistically significant ($P < 0.05$) directly intraoperatively and after 2 years of follow-up a minimum.

In Segmüller et al. [15] study, the mean forward flexion improved from a preoperative value of 90°−137° after arthroscopy. Mean abduction increased from a preoperative value of 78° to a postoperative value of 140°. A total of 50% of patients still had some restriction in internal rotation postoperatively; this may be attributed to not releasing the posterior capsule.

The risk of proximal humeral fracture during manipulation of a shoulder with adhesive capsulitis is well described in literature and has been noted to occur in as many as 3−5% of patients undergoing manipulation [16].

Most authors stated that the majority of patients who present with adhesive capsulitis usually between the age of 40 and 60 years [17]. This finding was the same in our study, as most patients were within this range.

In our study, patients aged from 39 to 68 years, with seven patients less than 50 years old and 11 patients aged above 50 years. The mean age of patients in this study was 54.28. There was no correlation between the age of the patients and the final outcome in all the prementioned studies, which differs from our study, in which patients aged less than 50 years had a greater improvement on the Constant−Murley score with score results increasing between 20 and 50, in comparison to patients older than 50 years whose score raised by 10−36.

There is a general consensus among authors that adhesive capsulitis is more common among females. In our study 11 out of 18 patients were females constituting more than 60% of the sample size. The sex of patient was not a prognostic variable affecting the outcome in our study. Both sexes showed almost equal improvement on the Constant−Murley score with males having mean increase of 25 and females having mean increase slightly higher of 27.5.

Harryman et al. [18] recorded similar observation. In contrast to this finding, Griggs et al. [19] and Shaffer et al. [20] reported that there was a trend towards worse results among male patients in their series.

There is a general consensus among the authors about the correlation between adhesive capsulitis and diabetes mellitus. Twelve out of 18 of the study's patients were diabetic presenting 66.7% of the study sample.

Despite that the majority of our cases being affected on the dominant hand (14 out of 18), there were no impact of hand dominance on the final results. Both had similar improvement with a mean score increase of 26.

4.1. Conclusion

Arthroscopic capsular release is an effective and safe method for treatment of refractory cases of frozen shoulder in which other treatment methods failed. It achieves dramatic pain and motion improvement immediately postoperative, allowing very early postoperative rehabilitation.

Conflicts of interest

There are no conflicts of interest.

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