ACTA
ORTHOPAEDICA
et
TRAUMATOLOGICA
TURCICA

Acta Orthop Traumatol Turc 2010;44(6):426-430
doi:10.3944/AOTT.2010.2423

Free coracoacromial ligament graft for augmentation of massive rotator cuff tears treated with mini-open repair

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Objectives: Repair of massive rotator cuff tears is a challenging and complex procedure. The tissue at the end of the torn tendons is often friable and weak, because ruptures are old and degenerated, and thus the ends must be sutured effectively and strongly to achieve a satisfactory outcome. We aimed to evaluate the effectiveness of free total or partial coracoacromial ligament (CAL) graft to protect and augment the repair of massive rotator cuff tears.

Methods: Forty six patients ((32 females, mean age 54.3 years (range 39-66 years)) operated for massive rotator cuff tears between January 2003 and June 2009 were included in the study. Twenty nine of these patients had right-sided tears, and 17 had left-sided tears. Fifteen of the tears were 3-4 cm wide (mean 3.5 cm); 27 were >4 cm wide (mean 4.5 cm), and 4 were >5 cm wide. The mean follow-up period was 26 months (range 16-52 months). Patients were operated with a mini-open technique, and reconstructed after primary repair with 18 total and 28 partial free transfer of the CAL. Patients were evaluated by Constant-Murley score, and the degree of active flexion and abduction. Tendon thickness was measured with ultrasonography during follow-up.

Results: Mean preoperative shoulder flexion was 27.5° (range 5-40°), and mean abduction was 22.5° (range 10-30°). Shoulder flexion was significantly greater postoperatively (mean 102.6°, range 70-150°), as was shoulder abduction (mean 96.5°, range 60-150°). Mean preoperative and postoperative Constant-Murley score was 45 and 80, respectively. Surgical complications, particularly recurrence, did not occur in any patient during the follow-up period. The integrity and tendon thickness of the repairs were similar to those of normal tendons at the end of follow-up.

Conclusion: Augmentation with a free transfer of the coracoacromial ligament provides excellent and promising functional results in the operative treatment of massive rotator cuff tears with a mini-open technique.

Key words: Rotator cuff; coracoacromial ligament; massive rotator cuff tears; surgery.

Treatment of massive rotator cuff tears is difficult due to retraction, degeneration, and fraying of the ends of the torn tendons, which make simple suturing of the ends inadequate.

Recurrence of rupture after treatment is frequently seen, along with muscular degeneration, leading to unsatisfactory clinical results.[1] To overcome these difficulties, orthopedic surgeons have developed procedures such as soft tissue releases, sliding cuff, and augmentation procedures. However, these procedures may still be inadequate to close the gap between the rotator cuff and the greater tuberosity of the humerus. Because the ends of the ruptured cuff are usually frayed and degenerated, suturing of the ruptured cuff often needs augmentation.

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Submitted: January 20, 2010 **Accepted:** June 21, 2010

Augmented repair of massive rotator cuff tears works well for old and retracted tears. Many techniques, such as latissimus dorsi or deltoid muscle flaps, have been described for an effective and strong repair, but they have had poor outcome.[2-7] The most important reasons for failure were donor site morbidity and altered mechanics after the transfer.

Based on the Lynn method, which is the use of plantaris tendon for achilles tendon repair, we developed a new technique for repairing massive tears of the rotator cuff. We chose the coracoacromial ligament (CAL), because it had been used before for coracoclavicular ligament repairs.[8] Its morphology and anatomy are appropriate for transfer, and the graft could be taken without making an additional incision.[9,10] We aimed to evaluate the effectiveness of free total or partial CAL graft to protect and augment the repair of massive rotator cuff tears.

Patients and methods

Between January 2003 and May 2009, 46 patients presenting with massive rotator cuff tears had rotator cuff repair with CAL augmentation in our tertiary care hospital. The mean age of patients was 54.3 years (range 39-66 years). Twenty-nine had rotator cuff tears on the right, 17 on the left. Most tears (67%) affected the dominant shoulder. Fifteen of the tears were 3-4 cm wide (mean 3.5 cm); 21 were >4 cm wide (mean 4.5 cm), and 4 were >5 cm wide. Mean follow-up was 26 months (range 16-52 months). All patients were evaluated with ultrasonography preoperatively, and 3, 6, and 12 weeks, and 1 year postoperatively. Ultrasonography evaluations were done by the same radiologists with GE Logiq machine with high frequency (10-14 Mhz, multifrequency); and acromiohumeral (AH) distance and rotator cuff integrity were evaluated.

Operation technique

We repaired the tears using a mini-open approach under general or regional (scalene block) anesthesia, with the patient in the beach chair position. The usual surgical incision was 5-6 cm long, anterior and parallel to the acromion (1-2 cm distal to acromion and 2-3 cm proximal to distal acromion). With this kind of mini-incision and with the help of good retraction, it was easy to reach the CAL and retracted rupture. This incision was designed after cadaveric dissections. After periosteal splitting of the acromion 1-2 cm proximal to the distal part of acromion, the CAL was clearly identified under the acromion, originating from the coracoid (Fig. 1). Subacromial decompression was also performed as a routine part of our procedure. Repairs were usually done with two bone anchors. Twenty-one ruptures were retracted about 1-2 cm. The retracted rotator cuff was released from coracoid where it was gener-

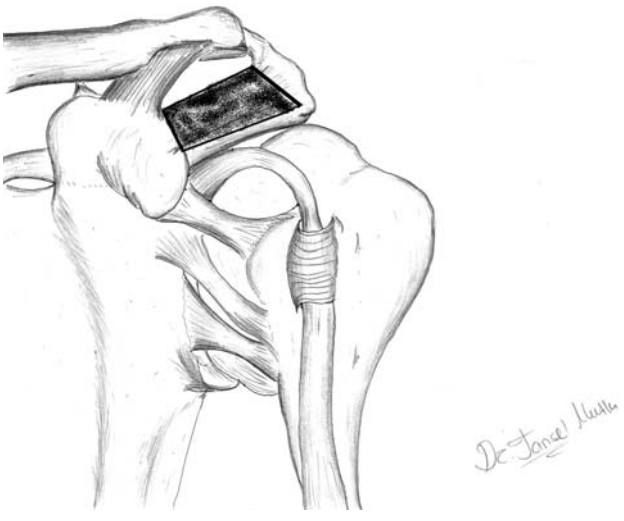

Fig. 1. Schematic presentation of total coracoacromial ligament excision (black part).

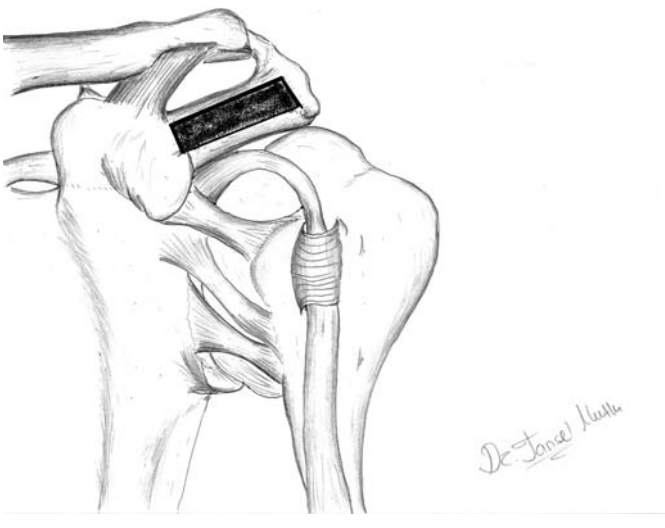

Fig. 2. Schematic presentation of lateral 2/3 coracoacromial ligament excision (black part).

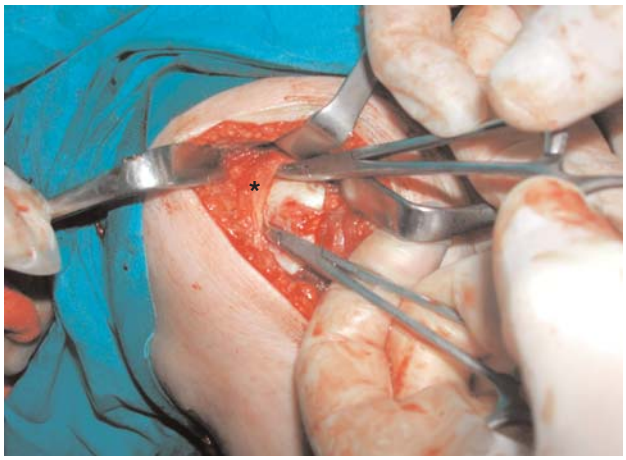

Fig. 3. Intraoperative dissection of the coracoacromial ligament (*).

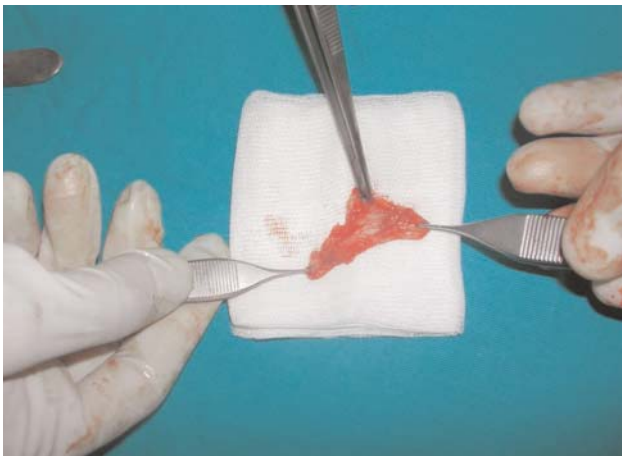

Fig. 4. Graft that was excised from the coracoacromial ligament.

ally adherent. After repairing the rotator cuff in routine fashion, excision of the CAL was performed.

In the first 18 cases, we excised the CAL totally (approximately 1.5x3 cm) (Fig. 2, 3), and found that humeral head migration was not occurring postoperatively. When no migration was detected under ultrasonography after a few test cases of partial CAL excision and transfer, we continued to excise and use only the lateral two-thirds of the CAL (approximately 1x2 cm, Fig. 4) for the rest of the cases. After excision, the CAL graft was sutured over the rotator cuff repair with 4-0 Vicryl, like a skin graft (Fig. 5). Generally, the grafts were large enough to bridge the gap and cover the ends of the torn cuff tendons.

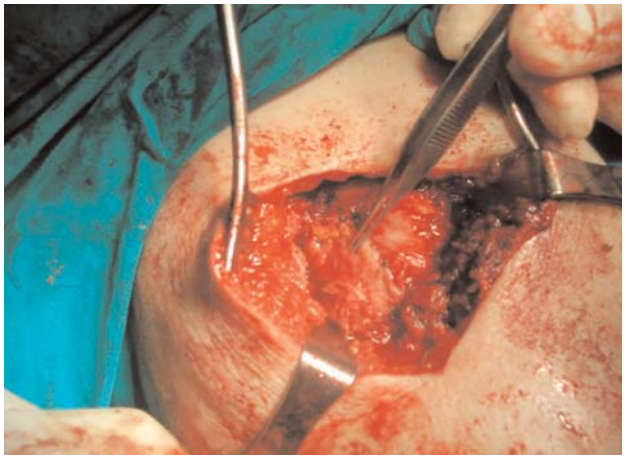

Fig. 5. Coracoacromial ligament graft sutured over the rotator cuff repair.

Results

Mean preoperative forward flexion was 27.5° (range 5-40°), and mean abduction was 22.5° (range 10-30°). Mean postoperative forward flexion was 102.6° (range 70-150°), and mean abduction was 96.5° (range 60-150°). The mean preoperative and postoperative Constant-Murley score was 45 and 80, respectively. Four of 21 patients with retracted tendons had gaps >5 cm wide from the old retracted ends of the tendon, such that closing the entire gap was not possible. The mean Constant score of these four patients was 62, which is not considered good.

AH distance increased dramatically from a mean <7 mm preoperatively to 9.5-10.5 mm 12 weeks postoperatively for partially excised CAL. Of interest, patients with total CAL excision had an increase <1.5 mm at 3 weeks; but after active exercises, AH distance increased to 9.5-10.5 mm at 12 weeks. There were no gaps or recurrence, suggesting that there was not any problem with the integrity of the repairs.

Discussion

Many studies in the Turkish literature documented successful repairs for massive rotator cuff tears with arthroscopic assisted mini-open[11] and open repair techniques.[12] For these kind of tears, the mini-open repair technique is easy and fast, and augmentation with CAL can be done with the same incision.

A wide gap between the ends of the rotator cuff tendons is usually present in massive, old rotator

cuff tears. Closure of the gap can be obtained by releasing the soft tissues, but even then a gap may remain between the ends of the ruptured tendons. Our aims for the CAL transfer were to close the gap, to augment the primary repair, and to protect the suture site from later impingements.

Initially, we excised the CAL completely. However, the total excision of the CAL may lead to humeral head migration due to loss of its anterosuperior stabilization function. Later in the patient series, we excised only two-thirds of the CAL to avoid excessive migration of the humeral head and impingement.[13] To evaluate this migration, all calculations about rotator cuff thickness and acromiohumeral distance were repeated during follow-up.

In patients with total CAL excision, the distance between the humerus and acromion decreased steadily during the early postoperative period. Humeral migration is lessened when the rotator cuff was strengthened through an active exercise program during the rehabilitation period. This interesting finding must be evaluated to determine the reason for AH distance returning to normal after total CAL excision. Is this from regeneration of the CAL, or is it from improved strength in the rotator cuff after active exercise? Additional studies should be performed to examine the amount of humeral migration after total CAL excision. Su et al.[14] suggested that one of the main reasons for translation of the humeral head was the gap in the rotator cuff defect.

Some authors claim that the CAL regenerates, regaining its normal mechanical properties after three years or more.[15-17] The ligament does have the ability to regenerate relatively quickly after subacromial decompression or acromioplasty, but it takes time to regain strength. The extent and speed of CAL regeneration should be a topic of further studies. There were no recurrent ruptures, therefore we did not surgically re-examine the shoulders with excised CAL, so we do not know if regeneration was present. We may perform a second-look arthroscopy to evaluate this possibility in the future studies. With evolving technology, we will likely have a chance to evaluate this topic in the future. Augmentation and protection of the repair for massive rotator cuff tears is the most important step determining the strength of the cuff after repair. In this study, 1.5x3 cm and 1x2 cm CAL grafts covered the primary repair adequately. With this technique, the gap was closed securely and the repair protected from further impingement.

In our study we chose the CAL because it has many advantages. First, CAL is more physiologic than allograft—CAL is the patient's own tissue; second, there is no need for additional incisions; third, it is technically easy to reach and harvest the CAL with our mini 5-6 cm incision; and fourth, there is no harm to healthy tendon or muscle. Early humeral head migration in total CAL excision has been seen as a disadvantage. But at follow-up, this migration returned to normal. A minor disadvantage of this procedure is that there is minimal arterial bleeding in front of CAL during total excision.

As measured by preoperative and postoperative Constant-Murley scores, our technique for repairing massive rotator cuff tears using the free transfer of CAL was very successful. It was also practical since it can be performed using a single incision. Further studies should examine humeral migration after total excision of CAL, compare total and partial excision of CAL for augmentation of rotator cuff repairs, and test for biomechanical properties of the rotator cuff after CAL transfer.

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