

Arthroscopic-assisted mini-open repair of rotator cuff tears

Rotator manşet yırtıklarının artroskopik yardımlı mini-açık yöntemle tamiri

Mehmet Ugur OZBAYDAR, Murat TONBUL, Cihangir YURDOGLU, Okan YALAMAN

Okmeydani Teaching Hospital, Orthopaedic Surgery Department, Istanbul

Amaç: Bu çalışmada rotator manşet yırtığı tanısıyla artroskopik yardımlı mini-açık yöntemle rotator manşet tamiri yapılan hastalar geriye dönük olarak değerlendirildi.

Çalışma planı: Büyük ve retrakte olmamış rotator manşet yırtığı saptanan 23 hastaya (7 erkek, 16 kadın; ort. yaşı 56; dağılım 41-75) artroskopik yardımlı mini-açık yöntemle rotator manşet tamiri yapıldı. On beş hastada sağ, sekiz hastada sol omuz tutulumu vardı; %83'te tutulum dominant tarafta idi. Hareket açıklıkları gonyometre ile, kas kuvvetleri manuel olarak ölçüldü. Hastalar ameliyat öncesi ve sonrasında fizik muayene, Amerikan Omuz ve Dirsek Cerrahları (ASES) skoru, UCLA skalası ve manyetik rezonans görüntüleme (MRG) ile değerlendirildi. Ortalama izlem süresi 32 ay (dağılım 12-61 ay) idi.

Sonuçlar: Tüm hastalarda orta boy yırtık saptandı. Üç hastada biceps tendonunda %50'den fazla yırtık olması nedeniyle biceps tenotomisi yapıldı. Ameliyat öncesinde ortalama 99° olan aktif öne fleksiyon ve 28° olan dış rotasyon açıklığı ameliyat sonrasında sırasıyla 161° ve 50° ölçüldü ($p<0.05$); supraspinatus ve infraspinatus kas kuvvetleri anlamlı artış gösterdi ($p<0.05$). Ameliyattan sonra UCLA skoru ortalama 31.6 bulundu. Dokuz hastada (%39.1) çok iyi, 12 hastada (%52.2) iyi, bir hastada (%4.4) orta, bir hastada kötü sonuc elde edildi. Ameliyattan önce ortalama 23.7 olan ASES skoru, ameliyattan sonra 92.4 bulundu ($p<0.05$). Ameliyattan sonra ortalama iyileşme süresi 1.7 ay (dağılım 1.5-12 ay) idi. Yirmi bir hasta (%91.3) ameliyattan memnun kaldığını bildirdi. Manyetik rezonans görüntüleme ile incelenen 16 hastanın üçünde (%18.8) yırtığın tekrarladığı gözlandı.

Çıkarımlar: Seçilmiş olgularda, rotator manşet yırtıklarında artroskopik yardımlı mini-açık yöntemle tamirin klinik ve fonksiyonel sonuçları başarılı bulundu.

Anahtar sözcükler: Artroskopi/yöntem; eklem instabilitesi/cerrahi; hasta memnuniyeti; hareket açıklığı, eklem; rotator manşet/yaralanma/cerrahi; omuz eklemi/cerrahi; manyetik rezonans görüntüleme.

Objectives: We retrospectively evaluated the results of patients who underwent arthroscopic-assisted mini-open repair of rotator cuff tears.

Methods: Twenty-three patients (7 males, 16 females; mean age 56 years; range 41 to 75 years) underwent arthroscopic-assisted mini-open repair for nonretracted rotator cuff tears. The right shoulder was involved in 15 patients and the left in eight patients; 83% being on the dominant side. The range of motion was measured with a goniometer, and muscle strength by manual examination. The patients were assessed by physical examination, the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), the UCLA scale, and magnetic resonance imaging (MRI). The mean follow-up was 32 months (range 12 to 61 months).

Results: All the patients had medium-sized ruptures. Biceps tenotomy was performed in three patients for tears affecting more than 50% of the biceps tendon. The mean preoperative active forward flexion increased from 99° to 161°, and active external rotation from 28° to 50° postoperatively ($p<0.05$); the strength of the supraspinatus and infraspinatus muscles increased significantly ($p<0.05$). The mean UCLA score was found as 31.6, showing an excellent result in nine patients (39.1%), good in 12 patients (52.2%), moderate in one (4.4%), and poor in one patient. The mean preoperative ASES score increased from 23.7 to 92.4 ($p<0.05$). The mean healing time was 1.7 months (range 1.5 to 12 months). Twenty-one patients (91.3%) were satisfied with the outcome. Of 16 patients with postoperative MRI scans, three (18.8%) exhibited recurrent ruptures.

Conclusion: In selective cases, the clinical and functional results are successful following arthroscopic-assisted mini-open repair for rotator cuff tears.

Key words: Arthroscopy/methods; joint instability/surgery; patient satisfaction; range of motion, articular; rotator cuff/injuries/surgery; shoulder joint/surgery; magnetic resonance imaging.

Rotator cuff tears which may cause disability of upper extremity, was known for a long time. In his article reporting the results of combination of acromioplasty together with mobilization and repair of rotator cuff, Neer pointed out the surgical treatment principles of rotator cuff repair. It is proven that successful results are achieved by open rotator cuff repairs in which these principles were used.

Rotator cuff repair is one of the most performed surgical treatments of the shoulder. Further advancement was notified in rotator cuff surgery with the improvement in repair techniques and new surgical equipments, in recent years. Surgical technique is improving traditional open repair to arthroscopically assisted mini open repair and further to full arthroscopic repair which is a less invasive method.

Beyond this it is still arguable that which is the best method in full thickness rotator cuff tear repair. But, full arthroscopic rotator cuff repair seems to replace the traditional open and mini open repair methods.

Arthroscopic rotator cuff repair has the advantages like prevention of deltoid muscle by using smaller incisions, arthroscopically release and mobilization of rotator cuff, lesser damage to soft tissue and probably due to this lesser pain in patient postoperatively, easier rehabilitation and lesser incidence of adhesive capsulitis development. But, in spite of improvements in proceedings of suture anchors, the arguments still continue on weakness of bone tendon fixation with full arthroscopic technique.

Arthroscopically assisted mini open repair of rotator cuff was first described by Levy et al. and improved by Paulos and Kody.

In our study, postoperative results of the patients whom arthroscopically assisted mini open rotator cuff repair was performed with the diagnosis of huge and unretracted full thickness rotator cuff tear, was evaluated and rerupture of rotator cuff was investigated by MRI.

Patients and methods

Arthroscopically assisted mini open rotator cuff repair was performed in 28 patients who had the

diagnosis of full thickness rotator cuff tear which did not respond to conservative treatment, in our clinic between 1999-2004. 23 patients (7 male 16 female, mean age 56, range 41-75) who had final examinations were taken into study.

Preoperative follow up time was 32 months (range 12-61) months. Left shoulders in 8 patients, right in 15 patients were involved. Involvement was at the dominant side in 83% patients.

Pre and postoperatively patients were evaluated with physical examination, ASES (American Shoulder and Elbow Surgeons scoring), UCLA and rerupture of rotator cuff by clinical findings and MRI.

In final examination, ROM of patients was measured with goniometer at sitting position. Muscle strength was evaluated manually.

ASES score (max 100 points) was calculated by evaluating daily living activity and visual pain score pre and postoperatively.

Pre and postoperative pain (10 points), function (10 points), active forward elevation (5 pts), manual forward flexion strength (5 pts) and patients satisfaction (5 pts) were evaluated with UCLA scale (max 35 pts). In this evaluation 0-20 pts poor, 21-27 pts fair, 28-33 pts good, 34-35 pts show excellent results.

Pre and postoperative taken MRI's were evaluated by the same radiologist who was unaware of the clinical diagnosis of the patients. Continuity of tendon or rerupture was evaluated with T₂ dominant coronal oblique and proton density dominant images and also MRI measurements named in short inversion recovery sequences. According to this the diagnosis of full thickness rerupture was put by getting signal image equivalent to liquid or unvisualized rotator cuff tendons in at least one of T₂ dominant or restrained fatty cross sections.

The size of tear found by measuring the widest opening following 1-2 mmetered mild debridement of rotator cuff tear. 1-3 cm tears were evaluated as medium, 2-5 cm tears as big, greater tears from 5 cm as huge. Average follow up period was found 32 months (range 12-61). T test was used for statistical evaluation.

Operative techniques

Patients were operated under general anesthesia and in beach chair position. Approaches were performed through posterior, anterior or lateral portals. Primarily acromion, distal clavicular, AC joint, coracoid and portal entrances were marked by a surgical marked pen. Posterior portal was opened at approximately 1,5 cm inferior and 1,5 cm medial of posterolateral corner of acromion. Anterior portal was opened at approximately 2-3 cm anterior of anterolateral corner of acromion, and also lateral portal was opened at approximately 2-4 cm lateral of posterior AC joint. Primarily arthroscopic evaluation of glenohumeral joint was performed through posterior portal. Intraarticular pathologies were treated.

And then we entered in subacromial space and bursa was excised with motorised shaver by opening lateral portal until the tear in rotator cuff totally visible. The size, the shape and if present the amount of the retraction of the tear was recorded. Quality and flexibility of the tissue was tested by grasping the tear by tendon grasper. For the cases in which the tendon was not mobile enough to be fixed easily into the adhesion point in humerus, the adhesions between tendon and glenohumeral capsule, coracohumeral ligament, acromion, deltoid fascia was tried to be released by motorised shaver and RF probe and the mobility of tendon was tried

to be improved. Later subacromial decompression was completed. Acromioplasty was performed in different amounts for each patient to gain smoother inferior surface of acromion for the purpose of providing enough space for rotator cuff tendons.

The edges of the tear and adhesion location of the tendon in greater tubercle was cleaned from soft tissues by debriding with shaver and punch through lateral portal.

Lateral of articular cartilage of humeral head was debrided with burr until reaching to a bleeding surface. Cortical bone was left untouched for powerful fixation of suture anchor.

Lateral portal incision was extended 1-2 cm upwardly and downwardly. Taking into consideration of axillary nerve which lies from front to backward through deltoid 5 cm distal to acromion; nerve was released distally up to 4-4,5 cm from acromion throughout deltoid fibers. We reached the tears on by passing through the layers. Depends upon the surgeon's choice, transosseous sutures or anchors were used for repair. Mason-Allen style sutures which was reported as the strongest tendon grasping method, was used for the tendon fixation with transosseous suture.

Medium size (1,3 cm) full thickness tear was determined in all of the patients. Furthermore, ten-

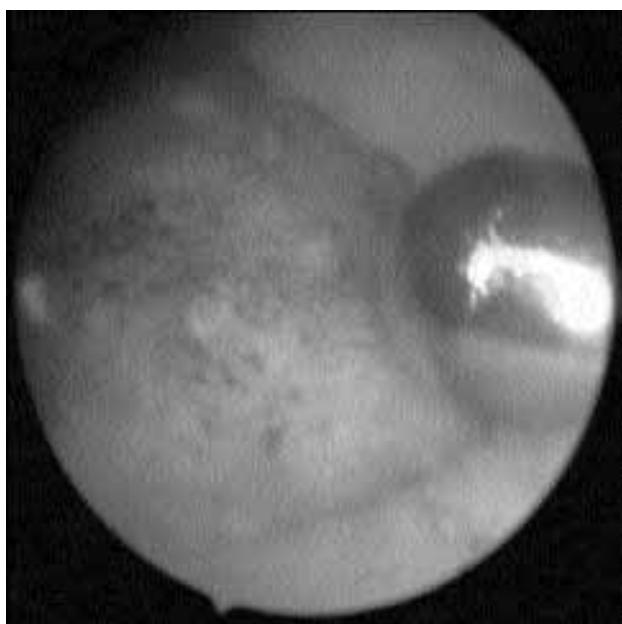


Figure 1. Arthroscopic view of rotator cuff tear.

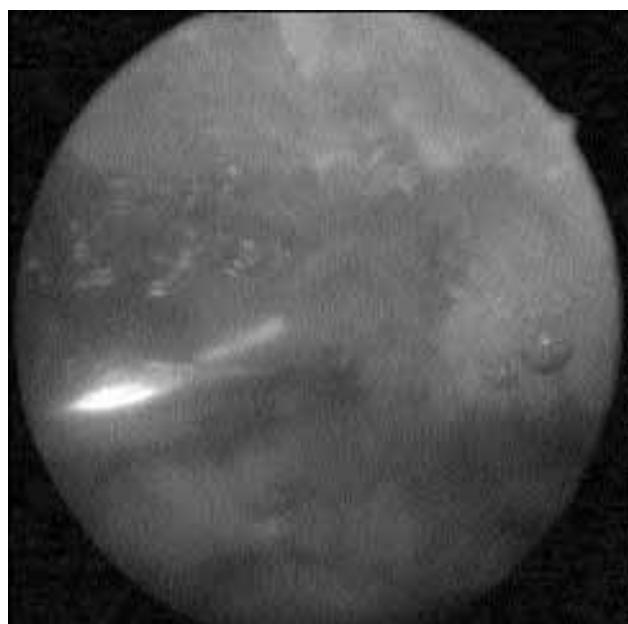


Figure 2. Subacromial decompression.

odesis because of biceps tendinitis in 3 patients, arthroscopic Bankart repair because of recurrent shoulder dislocation was performed in 1 patient.

Abduction pillowed arm brace and intermittent cold application with cryocuff was applied to the patients postoperatively. Pendulum and passive ROM exercises were started first day postoperatively and the patients sent home at second day. Arm brace was removed and stretching exercises which improves ROM was started at fourth week. Strengthening exercises were continued up to first year postoperatively.

Results

Diagnostic arthroscopy and arthroscopic subacromial decompression was applied to all patients. Middle size tear was determined in all. 1-3 5mm anchor in 14 patients, 2-4 transosseous sutures, both anchor and transosseous sutures in 2 patients were used for fixation of the torn tendon to bone. Biceps tenotomy was performed in 3 patients because biceps tendon was torn more than 50 percent.

Foreflexion and external rotation range showed expressive increase postoperatively ($p<0,05$ table 1). Pre and postoperative internal rotation range levels were shown in table 2.

Postoperative gained supraspinatus and infraspinatus muscle strengths showed meaningful increase compared to preoperative values ($p<0,05$

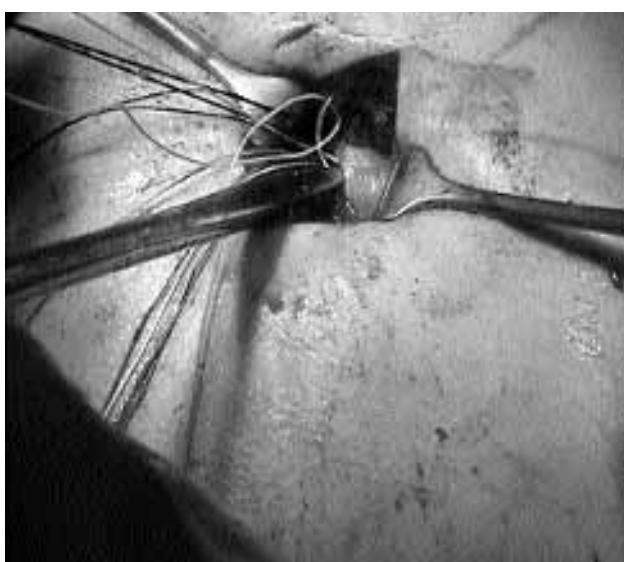


Figure 3. Mini-open repair

table 1).

Postoperative UCLA score was measured as mean 31,6(range 16-35). The results were very good in 9 patients (39,1%), good in 12 patients (52,2), fair in 1 patient (4,4%), poor in 1 patient. ASES score which was mean 23,7 preoperatively, was found 92,4 postoperatively ($p<0,05$ table 1). Postoperative mean recovery period was 1,7 months (range 1,5-12 months).

21 patients (91,3%) were happy, 2 patients (8,7) were unhappy with the results. 60 year old female patient who was unhappy with the surgery suggested that her complaints had started 20 years ago, she had been treated with NSAIDs and PT or 1 month prior to surgery but having no benefit from treatment. During her final examination she was complaining from pain, having difficulties in daily activities and still using pain killers. There was no limitation in motion. There was no difference in muscle strengths which was measured pre and post operatively; supraspinatus tendon remained intact in MRI.

The other patient who was unhappy with the surgery (male 68), suggested that his complaints had started 4 years ago he had used only NSAIDs preoperatively and also he had been using oral antidiabetics and antihypertensives for type 2 diabetes and hypertension. This patient who had primarily arthroscopic, secondly arthroscopically assisted mini open rotator cuff repair underwent surgery for his same shoulder, was feeling pain while performing overhead works and was in need of pain killers during his final examination. There was limitation in motion in forward elevation. Muscle strength was at the same level as preoperatively (2/5). MR imaging showed the recurrence of the tear.

Rerupture was observed in 3 of 16 patients (18,8%) whose MRI results were obtained. ASES score which was mean 20 (range 13-27) preoperatively was found 84 (73-95) postoperatively in 2 other patients who had reruptured. UCLA score was mean 29 (28-30) postoperatively.

Discussion

The usage of arthroscopy is increasing in rotator cuff surgery during last 10 years. The reason for

Table 1. Preop and postop functional results

	Preop	Postop	<i>p</i>
ROM			
Forward flex	99° (0-170°)	161° (130-180°)	<0.05
Add-ext rot	28° (0-70°)	50° (20-80°)	<0.05
Strength (manuel/max 5)			
Infraspinatus	3.2 (2-5)	4.3 (2-5)	<0.05
Supraspinatus	3.3 (2-5)	4.3 (2-5)	<0.05
UCLA score			
Pain	—	31.6 (16-35)	—
Function	—	9.0 (2-10)	—
Active forward ele	—	4.7 (2-5)	—
Forward flex strength	—	4.3 (2-5)	—
Patient satisfaction	—	4.6 (0-5)	—
ASES score			
VAS	23.7 (3-52)	92.4 (60-100)	<0.05
ADL	8.1 (3-10)	1.1 (0-8)	<0.05
	8.6 (0-30)	20.3 (19-30)	<0.05

VAS: Visual pain scale; ADL:Activite of daily living.

preference of this technique is that surgical procedure may be performed with a small incision without giving any harm to deltoid. After the beginning of performing arthromioplasty arthroscopically, also repair of rotator cuff tears with 3-4 cm incisions (mini open) between deltoid fibers were taken into consideration in the beginning of 1990's. Levy et al. who were one of the primary performers of this technique reported 80% good and very good results of 25 patients with 1 year follow up. Also Liu had very good results in 84% of 44 patients in 4 year follow up. 88% of the patients stated satisfaction from the procedure in the same study. Paulos and Kody reported 94% of 18 patients who were followed up for 46 months were

satisfied with the results. Functionally good and very good results were gained in 91% of the patients in our study, 91% of the patients were satisfied with the results.

It was notified that there was no meaningful difference between the 2 groups according to clinical results in the studies in which open repair and arthroscopically assisted mini open repair was compared. But it was found that necessity to analgesics was lesser, hospital stay shorter and returning to preoperative activities was quicker in mini open repair group compared to the other group; and also it was reported that better cosmetic result was gained, glenohumeral joint pathologies were better projected and origin of deltoid was preserved in mini open repair. Determination of intraarticular pathologies in 76% of the patients who had mini open rotator cuff repair, certified the importance of glenohumeral arthroscopy. Demirhan et al. performed tenodesis because of biceps tendinitis in 2 patients posterior capsular release in one patient while glenohumeral arthroscopy of 31 patients. In our study tenodesis for biceps tendinitis in 3 patients and Bankart repair for recurrent shoulder dislocation in 1 patient was performed during the same procedure.

It was reported that shoulder stiffness developed because of the injury in deltoid muscle fol-

Table 2. Preop and postop internal rotation

	Preop No	Postop No
T ₄	—	2
T ₇	1	5
T ₁₂	6	12
PSIS*	12	—
L ₁	2	2
L ₂	—	1
L ₅	2	1

PSIS: Posterior superior iliac spine

lowing appliance of classical mini open technique (11-20%). In our study shoulder stiffness was not determined in any patient postoperatively.

Presence of rerupture is one of the most frequently seen complications following rotator cuff repair. Reported rerupture rates following open rotator cuff repair differs between 13-68%.

Harriman et al determined rerupture in 20% of the 105 shoulders which they performed rotator cuff repair. In this study of which single tendon repair was done, it was reported that tissue quality effected the functional result and lesion type which determined while follow up was more important than of visualised while surgery; in patients who had recurrent full thickness tear following surgery shoulder strength was clearly lower than the patients who had strong tendon.

Gazielli et al. evaluated 100 shoulders with ultrasonography which they performed repair, and determined that rotator cuff was reruptured in 24% of the cases, got thinner but remained intact in 11% and was intact in 65%. In the same study it was presented that lesion type which determined while follow up of patients postoperatively, was related to clinical results.

Knutsen et al. investigated tendon wholeness following single tendon tear repair in 31 patients with MRI, determined rerupture in 32% of the patients while follow up, but could not find any relation between wholeness and functional results.

Gerber et al; evaluated 20 patients who had rerupture following rotator cuff repair and reported that there was significant improvement in patients according to their preoperative findings, rerupture was smaller than the primary tear, pain was relieved in patients in spite of tear presence, functional improvement including increase in abduction strength was determined.

In our study, rerupture was determined in 3 (18,8%) of 16 patients whom evaluated with MRI. Rerupture and clinical results were not congenial in patients; when physical examination and functional scores were taken into consideration.

Full arthroscopic rotator cuff repair is technically difficult and needs experience. Mini open technique is less complicated. While choosing for mini

open repair; patient expectation from surgery, mechanical properties of cuff tear, surgeon's experience and the results obtained from different techniques should be taken into consideration. Mini open technique may be preferred in patient who have muscle strength loss, need stronger repair and have repairable tear. Also the defect should not be big (3-5 cm), and there should not be no atrophy.

As conclusion, performance of arthroscopically assisted mini open rotator cuff repair combined with arthroscopic subacromial decompression in appropriate tears, provides preparation for easier repair of tear and protection of the adhesion point of deltoid. In this way postoperative pain decreases and rehabilitation advances easily.

References

1. Neer CS 2nd. Anterior acromioplasty for the chronic impingement syndrome in the shoulder: a preliminary report. *J Bone Joint Surg [Am]* 1972;54:41-50.
2. Yamaguchi K, Levine WN, Marra G, Galatz LM, Klepps S, Flatow EL. Transitioning to arthroscopic rotator cuff repair: the pros and cons. *Instr Course Lect* 2003;52:81-92.
3. Gartsman GM, Khan M, Hammerman SM. Arthroscopic repair of full-thickness tears of the rotator cuff. *J Bone Joint Surg [Am]* 1998;80:832-40.
4. Levy HJ, Uribe JW, Delaney LG. Arthroscopic assisted rotator cuff repair: preliminary results. *Arthroscopy* 1990;6:55-60.
5. Paulos LE, Kody MH. Arthroscopically enhanced "miniproach" to rotator cuff repair. *J Sports Med [Am]* 1994;22:19-25.
6. King GJ, Richards RR, Zuckerman JD, Blasier R, Dillman C, Friedman RJ, et al. A standardized method for assessment of elbow function. Research Committee, American Shoulder and Elbow Surgeons. *J Shoulder Elbow Surg* 1999;8:351-4.
7. Ellman H, Hanker G, Bayer M. Repair of the rotator cuff. End-result study of factors influencing reconstruction. *J Bone Joint Surg [Am]* 1986;68:1136-44.
8. Owen RS, Iannotti JP, Kneeland JB, Dalinka MK, Deren JA, Oleaga L, et al. Shoulder after surgery: MR imaging with surgical validation. *Radiology* 1993;186:443-7.
9. Gerber C, Schneeberger AG, Beck M, Schlegel U. Mechanical strength of repairs of the rotator cuff. *J Bone Joint Surg [Br]* 1994;76:371-80.
10. Liu SH. Arthroscopically-assisted rotator-cuff repair. *J Bone Joint Surg [Br]* 1994;76:592-5.
11. Demirhan M, Atalar AC, Kocabey Y, Akalin Y. Arthroscopic-assisted mini-open rotator cuff repair. [Article in Turkish] *Acta Orthop Traumatol Turc* 2002;36:1-6.
12. Demirhan M, Esenyel CZ. All arthroscopic treatment of rotator cuff tears. [Article in Turkish] *Acta Orthop Traumatol Turc* 2003;37 Suppl 1:93-104.
13. Harryman DT 2nd, Mack LA, Wang KY, Jackins SE, Richardson ML, Matsen FA 3rd. Repairs of the rotator cuff. Correlation of functional results with integrity of the cuff. *J Bone Joint Surg [Am]* 1991;73:982-9.

14. Gazielly DF, Gleyze P, Montagnon C. Functional and anatomical results after rotator cuff repair. *Clin Orthop Relat Res* 1994;(304):43-53.
15. Knudsen HB, Gelineck J, Sojbjerg JO, Olsen BS, Johannsen HV, Sneppen O. Functional and magnetic resonance imaging evaluation after single-tendon rotator cuff reconstruction. *J Shoulder Elbow Surg* 1999;8:242-6.