Early Postoperative Outcomes Between Arthroscopic and Mini-open Repair for Rotator Cuff Tears

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abstract

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The purpose of this study was to compare early postoperative outcomes between arthroscopic and mini-open repair for rotator cuff tears smaller than 3 cm to determine whether arthroscopic repair causes less postoperative pain and allows for faster recovery of range of motion. Sixty patients scheduled for rotator cuff repair were randomized to either an arthroscopic repair group (30 patients) or a mini-open repair group (30 patients). Pain level, range of motion, shoulder stiffness, and complications were compared between the 2 groups from immediately postoperatively to 6 months postoperatively.

Although no statistically significant difference was found in mean visual analog scale pain scores between the 2 groups during the 6 months postoperatively, mean visual analog scale pain score was significantly lower in the arthroscopic repair group compared with the mini-open repair group at postoperative days 1 and 2 (P=.02 and P=.04, respectively). No significant difference existed in postoperative range of motion, duration of rehabilitation, shoulder stiffness, or complications between the 2 groups; however, the use of additional analgesics in the arthroscopic repair group was significantly lower than in the mini-open repair group (P=.03).

Arthroscopic and mini-open repair had equivalent clinical outcomes in the early postoperative period. The hypothesis that arthroscopic repair would cause less postoperative pain and allow faster recovery of range of motion in the early postoperative period compared with mini-open repair was not supported.

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Arthroscopic repair of the rotator cuff is an increasingly popular method, one for which many authors have reported satisfactory outcomes.[1-3] Its potential advantages include less postoperative pain, low deltoid morbidity, shorter hospital stay, faster rehabilitation, and earlier return to activities of daily living.[4-7] Despite these advantages, arthroscopic repair of the rotator cuff is technically demanding and requires a large-volume practice for a surgeon to become proficient in this procedure.[4,8] Because of the technical demands of arthroscopic repair, many surgeons consider the mini-open technique to be the first choice for rotator cuff repair. Mini-open repair is a well-established method with the potential advantages of causing less deltoid morbidity and being an easier technique.[1,9] Satisfactory clinical outcomes have been well documented and compare favorably with those for open or arthroscopic techniques.[3,8-15]

Several systematic reviews and meta-analyses have demonstrated that no significant difference exists in mid- and long-term clinical outcomes between arthroscopic and mini-open repair.[1,2,16,17] However, most of those studies were of low quality in that samples were not randomized and follow-up was retrospective in nature. In addition, few studies have compared the 2 techniques with respect to level of postoperative pain and range of motion in the early postoperative period. The current study compared early postoperative outcomes between arthroscopic and mini-open repair for rotator cuff tears of smaller than 3 cm to test the hypothesis that, of the 2 techniques, arthroscopic repair would cause less postoperative pain and allow for faster recovery of range of motion.

Materials and Methods

Patient Population

This study was approved by the authors' institution's Review Board of Research Ethics. Between March 2008 and December 2009, a total of 60 patients (34 men and 26 women) at the authors' institution who were scheduled to undergo repair for rotator cuff tears smaller than 3 cm were enrolled in the study. Patients were randomized to either a mini-open or arthroscopic repair group after providing written informed consent. The first consecutive 30 patients underwent mini-open repair, and the next consecutive 30 patients underwent arthroscopic repair. A power analysis revealed the need for at least 27 patients in each group to reach statistical significance. To avoid selection bias because of the learning curve for arthroscopic repair, the 30 patients undergoing arthroscopic repair were enrolled in the study 12 months after the 30 patients undergoing mini-open repair were enrolled.

Inclusion criteria were intraoperative confirmation of the presence of a supraspinatus tear smaller than 3 cm. Exclusion criteria included the presence of a large to massive tear (greater than 3 cm) and the necessity of an additional procedure such as biceps tenodesis, repair of a superior labral tear from anterior to posterior, or distal clavicular resection. All procedures were performed by the same surgeon (C.-C.H.).

Pain level and range of motion from immediately postoperatively to 5 days, 2 and 6 weeks, and 3 and 6 months postoperatively were compared between the 2 groups. In addition, duration of postoperative rehabilitation, postoperative shoulder stiffness, length of hospital stay, use of additional analgesics, and postoperative complications were compared.

Mean patient age was 55.8 years (range, 39-69 years). Nine patients had a partial rotator cuff tear, 17 had a small tear, and 34 had a medium tear. No statistically significant differences were found between the 2 groups with regard to age, sex, body mass index, preoperative shoulder stiffness, duration of surgery, tear size, or repair technique (Table 1).

Postoperative Pain Management

In both groups, postoperative pain was controlled according to the authors' standard multimodal protocol, which has been described elsewhere.[18] A 50-mL cocktail of local analgesics containing morphine and 0.75% ropivacaine dissolved in 0.9% normal saline was injected intraoperatively into the intra-articular cavity, subacromial space, muscle layer, and fatty and subcutaneous layers. For postoperative pain control, immediate-release oxycodone, acetaminophen, and a cyclooxygenase-2 selective inhibitor were administered orally until postoperative day 2. From postoperative days 3 to 5, a tablet containing a combination of 37.5 mg of tramadol and 325 mg of acetaminophen was prescribed, along with a cyclooxygenase-2 inhibitor. For additional postoperative pain control beyond that provided by the authors' regular regimen, intramuscular diclofenac was added if required.

Patients rated their pain using a visual analog scale (VAS) ranging from 0 (no pain) to 10 (unbearable pain) preoperatively; immediately postoperatively; daily between postoperative days 1 and 5; and at 2 and 6 weeks and 3 and 6 months postoperatively. Range of shoulder motion was checked daily, beginning on postoperative day 1, using a continuous passive motion machine. Days on which patients could achieve 120° of flexion and 30° of external rotation were recorded.

Surgical Technique

With patients in the lateral decubitus position, a standard arthroscopic glenohumeral examination was performed under general anesthesia through the posterior and anterior portals to evaluate intra-articular pathology. The arthroscope then was placed in the subacromial space, and arthroscopic subacromial decompression was performed through a lateral portal using an acromionizer burr.

For the mini-open repair group, a 3- to 4-cm skin incision was made from the anterolateral edge of the acromion to the

distal edge, and dissection was made to the raphe between the anterior and middle deltoid. After preparing the footprint using a ring curette or rasp, the torn tendon was repaired using either the single-row (n=7) or double-row (n=23) repair technique with a suture anchor.

For the arthroscopic repair group, after a posterolateral portal for viewing was created, the tear was adequately mobilized and repaired by attaching the supraspinatus to the prepared greater tuberosity using either the single-row (n=5) or double-row (n=25) repair technique with a suture anchor. The number of anchors and sutures used depended on the tear size and pattern.

Postoperative Rehabilitation

The postoperative rehabilitation protocol was the same for both groups. Wearing an abduction brace, patients engaged in pendulum and continuous passive motion machine exercises until postoperative day 5, and then passive range-of-motion exercises were started. Active range-of-motion exercises were started at 6 weeks postoperatively, muscle-strengthening exercises were started at 3 months, and occupational or sports activities were started at 6 months.

Statistical Analysis

A sample size of 27 patients in each group was calculated by 20% difference of VAS pain score at a level of .05 and a β value of .80. Statistical analysis was performed using SPSS version 14.0E software (SPSS Inc, Chicago, Illinois). Frequency and descriptive statistics were analyzed to examine baseline characteristics, and *t* and chi-square tests were used to determine the significance of differences between the 2 groups. Statistical significance was set at a *P* value less than .05.

RESULTS

No statistically significant differences were found in mean VAS pain scores measured immediately postoperatively and 5 days, 2 and 6 weeks, and 3 and 6 months postoperatively between the arthroscopic and mini-open groups ($P>.05$). Mean scores for the arthroscopic repair group were significantly lower compared with the mini-open repair group on postoperative days 1 and 2 ($P=.02$ and $P=.04$, respectively) (Figure 1). In addition, no statistically significant differences were found in mean range of motion (forward flexion and external rotation) 5 days, 2 and6 weeks, and 3 and 6 months postoperatively between the 2 groups ($P>.05$) (Figures 2, 3).

The average duration of postoperative rehabilitation required for patients to achieve 120° of flexion and 30° of external rotation was 3.9 and 4.1 days in the arthroscopic and mini-open groups, respectively. The number of instances of consumption of additional analgesics through postoperative day 5 was 1 and 1.9 in the arthroscopic and mini-open groups, respectively. The average length of hospital stay was 9.2 and 8.7 days in the arthroscopic and mini-open groups, respectively. At 6 months postoperatively, stiffness was present in 5 and 4 patients in the arthroscopic and mini-open groups, respectively. Although no

Table 1

Patient Demographics

Demographic	Arthroscopic Repair Group (n=30)	Mini-open Repair Group (n=30)	*P*
Mean age, y	55.5±7.8	56.2±7.9	.72
No., M:F	17:13	17:13	1.00
Mean BMI, kg/m^2	24.0±2.1	23.7±2.8	.64
Preoperative stiffness, No.	4	4	1.00
Mean operative time, min	57.7±11.0	61.0±14.7	.32
Tear size, No.			.57
Partial	5	4	
Small	10	7	
Medium	15	19	
Repair technique, No.			.69
Single row	5	7	
Double row	25	23	

Abbreviation: BMI, body mass index.

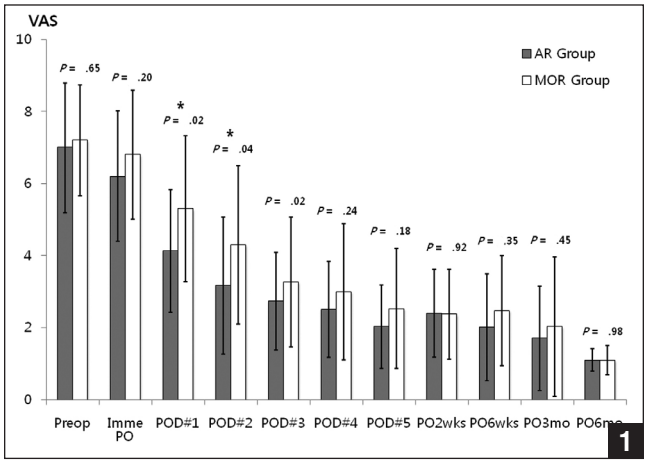

Figure 1: Mean visual analog scale (VAS) pain scores measured preoperatively, immediately postoperatively, on days 1-5, and at 2 and 6 weeks and 3 and 6 months postoperatively are shown. No statistically significant difference was found in mean VAS pain scores between the 2 groups 6 months postoperatively except on postoperative days 1 and 2, when the mean pain score for the arthroscopic repair group was significantly lower than that for the mini-open repair group. An asterisk denotes a statistically significant difference between the 2 groups. Abbreviations: AR, arthroscopic repair; Imme, immediately; MOR, mini-open repair; PO, postoperative; POD, postoperative day; Preop, preoperative.

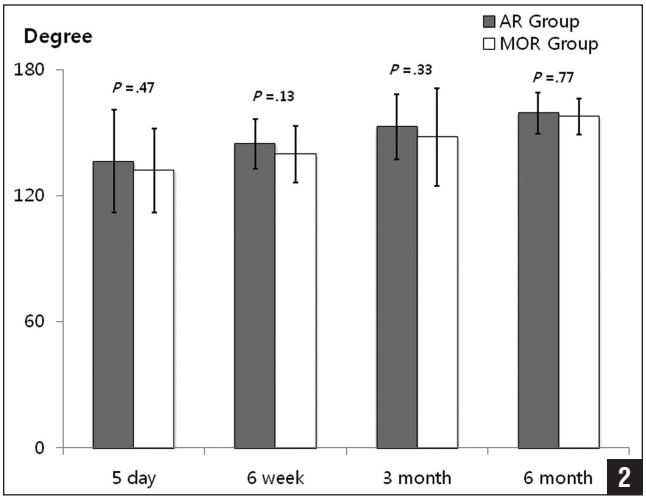

Figure 2: Graph showing forward flexion improved serially by 5 days, 2 and 6 weeks, and 3 and 6 months postoperatively. No statistically significant difference was found between the 2 groups at serial follow-up assessments. The error bars show the standard error of the mean. Abbreviations: AR, arthroscopic repair; MOR, mini-open repair.

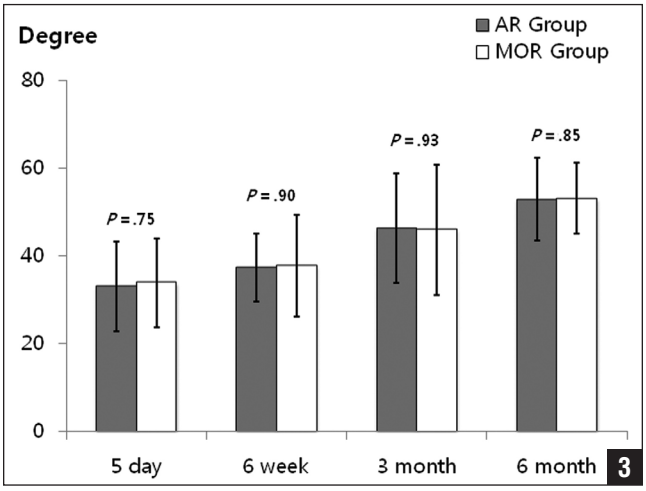

Figure 3: Graph showing external rotation improved serially by 5 days, 2 and 6 weeks, and 3 and 6 months postoperatively. No statistically significant difference was found between the 2 groups at serial follow-up assessments. The error bars show the standard error of the mean. Abbreviations: AR, arthroscopic repair; MOR, mini-open repair.

statistically significant differences were found in duration of postoperative rehabilitation, length of hospital stay, or postoperative stiffness between the 2 groups ($P>.05$), the use of additional analgesics in the mini-open repair group was significantly higher compared with that in the arthroscopic repair group ($P=.03$) (Table 2). No local complications (eg, deltoid morbidity or infection) were observed in either group.

Discussion

The most important finding of this study was that no significant difference existed in pain scores, range of motion, or perioperative or postoperative morbidity between the arthroscopic and mini-open repair groups during the 6 months postoperatively, but pain relief was significantly better on postoperative days 1 and 2 in the arthroscopic repair group compared with the mini-open repair group. The authors failed to prove their hypothesis that arthroscopic repair would cause less postoperative pain and allow faster recovery of range of motion in the early postoperative period compared with mini-open repair.

Appropriate peri- and postoperative pain management for patients undergoing rotator cuff repair has been a major issue that can influence the effectiveness of treatment and rehabilitation. Furthermore, it has been an important measure for use in judging postoperative satisfaction with rotator cuff repair.

Arthroscopic repair has become an increasingly popular method and has been shown to have clinical success equivalent to that of mini-open repair, with perceived advantages of less pain for patients, reduced risk for stiffness, and fast recovery.[4-6,16,19-21] Many researchers have reported no significant difference in mid- and long-term clinical outcomes between arthroscopic and mini-open repair.[3,8,11-15] Kim et al[22] reported that arthroscopic repair of full-thickness rotator cuff tears had an equal outcome to that of technically unsuccessful arthroscopic repairs, which were salvaged by conversion to the mini-open repair technique. The authors also reported that surgical outcome depended on the size of the tear rather than the method of repair. Warner et al[13] found no difference in outcome between arthroscopic repair vs mini-open repair, and they noted that the choice of one approach over the other is best based on surgeon or patient preference.

Several authors have reported that arthroscopic repair tends to produce less pain and faster postoperative rehabilitation than open repair or mini-open repair in the immediate postoperative period.[7,19,23,24] Köse et al[24] reported that their arthroscopic repair group had similar clinical results but shorter hospital stays compared with their mini-open repair group. Millar et al[21] reported that mean American Shoulder and Elbow Surgeons scores were significantly higher and range of motion was significant better in their arthroscopic repair group compared with their open repair group at 6 weeks, 3 and 6 months, and 2 years postoperatively. Kang et al[20] reported that arthroscopic repair was associated with statistically significantly less pain compared with mini-open repair at 3 and 6 months postoperatively for small and medium tears. However, most published reports comparing the 2 methods are based on retrospective studies and have shown no evidence for the superiority of arthroscopic repair regarding early postoperative clinical outcomes.

Liem et al[8] reported that arthroscopic repair produced equivalent satisfactory clinical results and tendon integrity compared with mini-open repair. They concluded that early range of motion did not

differ significantly at 6 weeks or 3 months postoperatively.

Kasten et al[25] reported that VAS pain scores were similar in their arthroscopic and mini-open repair groups for the first 3 weeks postoperatively but that the mini-open repair group had less pain from weeks 4 through 8. Less use of analgesics was observed during the first postoperative week in their arthroscopic repair group, indicating less pain, but VAS pain scores were higher in weeks 4 through 8 compared with the mini-open repair group. The authors concluded that both techniques are equivalent regarding outcomes in this period. However, their study was limited in that the sample size was small and the repair techniques used were not identical.

Few prospective studies were found comparing perioperative and early postoperative clinical outcomes, such as level of postoperative pain, range of motion, length of hospital stay, use of analgesics, and postoperative complications, between arthroscopic repair and mini-open repair. When compared between the 2 current groups, no significant differences were found for the 6-month postoperative period, except that the mean VAS pain score in the mini-open repair group was significantly higher than in the arthroscopic repair group on postoperative days 1 and 2. Splitting the deltoid and surgical retraction in the mini-open repair group might have been the cause of higher VAS scores compared with the arthroscopic repair group at postoperative days 1 and 2, necessitating the use of additional analgesics in the mini-open repair group.

One of the potential drawbacks of mini-open repair is postoperative shoulder stiffness, which has a reported incidence ranging between 11% and 20%.[1] Several studies reported an increased incidence of stiffness after mini-open repair compared with arthroscopic repair.[1,2,6] The current results contrast those of previous studies, with both groups demonstrating similar incidences of postoperative stiffness (16.7% [n=5] in the arthroscopic repair group and 13.3% [n=4] in the mini-open repair group). Because the current study covered a short period, further evaluation is needed to determine the true incidence of postoperative shoulder stiffness for the 2 repair methods.

Table 2

Functional Recovery, Use of Additional Analgesics, and Postoperative Shoulder Stiffness

Variable	Arthroscopic Repair Group (n=30)	Mini-open Repair Group (n=30)	*P*
Motion recovery, d	3.9±1.9	4.1±2.2	.71
No. of times additional analgesics administered	1.0±1.3	1.9±1.7	.03[a]
Postoperative stiffness, No.	5	4	.78

[a]*Statistically significant difference between the 2 groups.*

The strengths of this study were its prospective design, the fact that all evaluations and procedures were performed by a single surgeon, and the fact that the fixation technique used suture anchors for both mini-open and arthroscopic repair. In addition, selection bias was avoided because of the learning curve for arthroscopic repair by enrolling 30 patients who underwent arthroscopic repair 12 months after the procedures in the mini-open repair group were performed.

The limitations of this study included the relatively small sample size that was used to claim a strong statistical power, the lack of randomization, and the lack of assessment of the structural integrity of repaired rotator cuffs by ultrasonography or magnetic resonance imaging. Further research with a larger number of patients and well-established randomization is necessary.

CONCLUSION

This prospective, comparative cohort study demonstrated that arthroscopic and mini-open repair produce equivalent clinical outcomes in the early postoperative period. The hypothesis that arthroscopic repair would cause less postoperative pain and allow faster recovery of range of motion in the early postoperative period compared with mini-open repair was not supported. Therefore, the choice of repair method should be based principally on the experience and preference of the surgeon.

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