Arthroscopic rotator cuff repair using modified Mason-Allen versus double row suture bridge techniques

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Abstract

Background
Arthroscopic double row repair technique of rotator cuff tendon tears compared to the modified Mason-Allen single row technique is an issue of dispute.
Purpose
The purpose of this study is to analyze and compare the functional outcomes following arthroscopic rotator cuff repair using the modified Mason-Allen (MMA) versus the double row (DR) suture bridge techniques.
Patients and Methods
Fifty patients with torn rotator cuff tendons entered this randomized prospective study. They were assigned into group A using the modified Mason-Allen technique and group B using the double row suture bridge technique. The American Shoulder and Elbow Surgeons (ASES), constant scores and visual analogue scale (VAS) were used for clinical follow up at 6months, 1 and 2 years.
Results
The mean follow-up periods were 49.1 ± 1.41 months and 49.04 ± 1.07 months in group A and group B respectively.
The mean constant Shoulder scores in group A improved to 82.19 ± 1.75 and to 82.39 ± 1.56 in group B at 2 years postoperative, while the mean ASES score improved to 89.86 ± 1.28 and to 90.35 ± 1.82 in group A and B respectively at 2 years postoperative. The mean VAS scores improved to 0.95 ± 0.74 and to 0.96 ± 0.71 in group A and group B respectively.
There were no statistically significant differences between the two groups regarding the clinical outcomes assessed by the constant, ASES and VAS at final follow up.
Conclusion
The modified Mason-Allen can be considered a reliable, simple and less costing repair technique for rotator cuff tears with comparable functional results to the double row suture bridge repair technique.
Level of Evidence
Level III, prospective comparative study.

Keywords
Modified Mason-Allen, rotator cuff tear, Suture anchor, double row, single row.

Introduction

Arthroscopic rotator cuff (RC) repair is a common surgical procedure and has evolved from simple debridement to arthroscopic repair [1].

Although several studies have proven that arthroscopic RC repair short-term clinical results are similar to those of the traditional mini open repair [2,3], arthroscopic repair has the advantages of less postoperative morbidity and pain, no deltoid detachment, and better cosmetic appearance [4]. Nevertheless, structural failure, inadequate healing, and re-tears have been reported after arthroscopy [5,6].

As the goal of RC repair is to restore the anatomical continuity between the tendon and the bone and to regain the original mechanical properties, various configurations and types of sutures have been used to achieve this goal and were biomechanically tested [3].

Double row (DR) repair has been introduced in order to restore the RC footprint by insertion of medial and lateral rows of anchors to obtain larger area of tendon re-fixation over the greater tuberosity [7,8].

Single row repair may result in an improper tendon-bone contact resulting in incomplete healing and insufficient mechanical stability of the construct [9,10]. Scheibel and Habermeyer [11] developed the modi-

fied Mason-Allen (MMA) technique which is a complex single row technique that can be utilized both in the mini-open and arthroscopic RC repair and has several advantages including easy performance and provision of excellent stability to the reattached tendons.

The aim of our study is to compare the functional outcomes of both the modified Mason-Allen and the double row suture bridge techniques following arthroscopic RC repair.

Patients and Methods

50 patients who were managed with an arthroscopic RC repair were included in this randomized prospective study, 6 (12%) patients were lost in the follow-up period after surgery or refused to take part in this study. 21 patients were treated using the modified Mason-Allen technique in group A, while 23 patients underwent double row suture bridge repair in group B after informed consent was obtained from all patients.

The random assignment of all patients to enter either group was computerized using simple randomization.

Diagnosis confirmation was based on the patient history, clinical examination, and radiological assessment by plain radiographs and magnetic resonance imaging (MRI).

The inclusion criteria were: (1) presence of a symptomatic C_2 or C_3 full-thickness tear of the rotator cuff muscles, according to Snyder Southern California Orthopedic Institute (SCOI) rotator cuff classification system [12], (2) failure of conservative management for at least 3 months.

The exclusion criteria were: (1) a combined full-thickness subscapularis tendon tear requiring concomitant repair, (2) repair following transformation of a partial thickness rotator cuff tear to a full thickness lesion, (3) radiographic evidence of proximal humeral migration, and (4) fatty infiltration of the rotator cuff muscles greater than Goutallier [13,14] stage II, (5) history of previous surgery to the involved shoulder or associated cervical lesions.

There were 14 males and 7 females in group A, while group B included 16 males and 7 females. The mean age was 50.7 years for group A and 48.4 for group B. Of the operated shoulders, 32 (72.7%) were the right shoulders and 12 (27.3%) were the left shoulders; 31 (70.5%) of the patients had the surgery on the dominant shoulder. The mean time interval between injury and surgery was 6.19 ± 1.40, 6.17± 1.77 months for group A and group B respectively. According to Snyder Southern California Orthopedic Institute (SCOI) rotator cuff classification system, there were 10 cases with C_2 and 11 cases with C_3 rotator cuff injury in group A, while group B included 11 cases with C_2 and 12 cases with C_3 rotator cuff injury (Table 1). There was no preoperative statistically significant difference between the 2 groups.

Table 1: Patients demography

	Group (A) MMA n=21	**Group (B) DR n=23**	**p value**
Age at trauma in years (Mean ± SD)	50.71 ± 5.63	48.48 ± 6.33	0.22
Sex Males Females	 14 (66.7%) 7 (33.3%)	 16 (69.6%) 7 (30.4%)	0.84
Dominant side affection	15 (71.4%)	16 (69.6%)	0.89
Snyder Classification: C_2 C_3	 10 (56.5%) 11 (43.5%)	 11 (52.3%) 12 (47.7%)	0.78
Goutallier Fatty infiltration: Grade 0 Grade 1 Grade 2	 5 (23.8%) 10 (47.6%) 6 (28.6%)	 4 (17.4%) 12 (52%) 7 (30.4%)	0.87
Rotator cuff tendon retraction (cm) Mean ± SD	 1.48 ± 0.52	 1.48 ± 0.51	0.99
Duration of symptoms in months (range) Mean ± SD	(4-9) 6.19 ± 1.40	(4-10) 6.17± 1.77	0.97

SD: standard deviation.; MMA: modified Mason-Allen.; DR: double row; n: number of patients.

Clinical outcomes were evaluated using the American Shoulder and Elbow Surgeons (ASES), Constant scores, and visual analogue scale (VAS) at 6 months, 1 and 2 years postoperative for both groups.

All statistical calculations were done using computer program IBM SPPS (statistical package for the social science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows. Data were statistically expressed in the form of mean ± standard deviation (± SD), range, frequencies and percentages when appropriate. Numerical variables were compared between the two groups using the Student *t* test for independent samples for comparing normally distributed data while the Mann Whitney *U* test was used for independent samples for comparing not-normal data. Chi-square ($\chi 2$) or Fisher's exact test were used to analyze categorical data as appropriate. p values less than 0.05 was considered statistically significant.

Surgical technique

All surgical steps were carried out under general anesthesia with the patients adjusted in the beach-chair position. Diagnostic arthroscopy of the glenohumeral joint was first performed using the standard posterior portal. Tenotomy or tenodesis of the long head of the biceps tendon was done according to the pathological condition and preoperative findings on physical examination, followed by debridement of the articular surface of the rotator cuff tear.

The arthroscope was then shifted to the sub-acromial space through the posterolateral (viewing) portal where bursectomy followed by acromioplasty were routinely done through the (working) lateral portal.

Mobilization of the rotator cuff was done by releasing the coracohumeral ligament, the superior capsule, and/or the rotator interval as needed to allow the tissue edges to be reduced without tension over the greater tuberosity. Preparation of the footprint was done until a bleeding surface was achieved.

For the Modified Mason-Allen group, a double loaded 5.0 mm suture anchor was inserted at an angle of approximately 45^0 at least 10 mm lateral to the articular surface so as to increase the area of bone-tendon contact.

A horizontal mattress stitch was performed by routing both free limbs of the first suture through the tendon from intra-articular into the sub-acromial space using suture passing devices. The sutures were placed approximately 10 mm from the tendon edge and approximately 10 mm apart from each other. Then a simple stitch was done using the free limbs of the second suture, and passed between the previous mattress suture approximately 1 to 2 mm more medially. The horizontal mattress suture was tied first, followed by the vertical simple stitch on top of it (Figure 1).

For the double row suture bridge technique, one row of single loaded suture anchors was inserted approximately 10 to 12 mm apart in the medial portion of the footprint, just lateral to the humeral head articular surface. The medial row suture limbs were passed across the tendon approximately 12 to 15 mm medial to tendon edge. The sutures of the medial anchors were tied first and left uncut to be used in the lateral row anchors. Debridement of the insertion sites of the lateral row anchors was done. A single limb from each medial anchor suture was passed through the eyelet of a knotless Pushlock anchor to establish the second lateral row anchorage (Figure 2).

Figure (1): arthroscopic view of final repair using the modified Mason-Allen technique

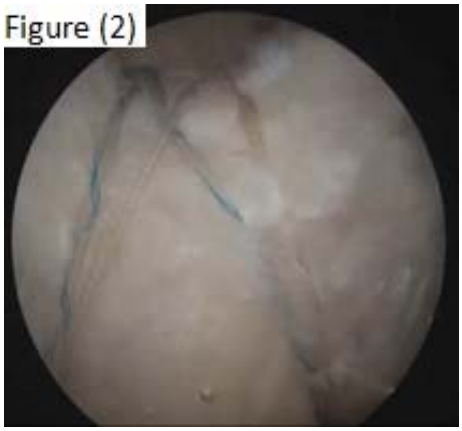

Figure (2): arthroscopic view of final repair using the double row suture bridge technique

Both groups followed the same rehabilitation protocol where the shoulder was immobilized in an abduction brace for 6 weeks. Pendulum exercises were permitted 3 weeks postoperative, while patients started to perform strengthening exercises for the rotator cuff 6

weeks after surgery under the supervision of a qualified physical therapist.

Results

The mean follow-up periods were 49.1 ± 1.41 months for the MMA group and 49.04 ± 1.07 months for the DR group.

Statistical analysis of the MMA group data showed significant increase of the ASES, constant scores and VAS at final follow up compared to the preoperative values, also the DR group showed significant increase of the same scores at final follow up (p value <0.001).

The mean constant score in the MMA group improved from 50.62 preoperative to 82.19 at 2 years postoperative, while in the DR group it improved from 50.35 to 82.39 respectively, however comparison of the final constant scores in both groups showed no statistically significant differences at final follow up (P value =0.69).

The mean ASES scores in the MMA group improved from 38.52 preoperative to 89.86 at 2 years postoperative, while in the DR group it improved from 38.43 to 90.35 respectively. Furthermore, comparison of the ASES scores in both groups was not statistically significant at final follow up (P value =0.31).

The mean VAS in the MMA group improved from 4.95 preoperative to 0.95 at 2 years postoperative while the mean VAS scores in the DR group improved from 4.91 to 0.96 respectively. Comparison of the VAS in both groups showed no statistically significant differences at final follow up (P value =0.99) (Table 2).

The number of suture anchors used in the MMA group repair was significantly less than that of the DR group (p value <0.001).

Table (2): Functional outcomes of both groups assessed by VAS, ASES and Constant scores measured preoperative and at 6months, 1 and 2 years postoperative

	Group A (MMA) n=21	**Group B (DR) n=23**	**P value**
Follow up period in months Mean ± SD	49.1 ± 1.41	49.04 ± 1.07	0.89
Constant score Mean ± SD, (range)			
Preoperative Constant	50.62 ± 2.94 (46-54)	50.35 ± 2.77 (46-55)	0.75
Postoperative Constant 6 months	78.14 ± 1.46 (75-80)	77.43 ±1.75 (74-80)	0.16
Postoperative Constant 1 year	80.71 ± 1.65 (77-84)	80.26 ± 1.57 (78-84)	0.36
Postoperative Constant 2years	82.19 ± 1.75 (80-86)	82.39 ± 1.56 (80-86)	0.69
ASES score Mean ± SD, (range)			
Preoperative ASES	38.52 ± 2.38 (34-42)	38.43 ± 2.79 (34-45)	0.91
Postoperative ASES 6 months	85.24 ± 1.58 (81-88)	85.74 ± 1.36 (83-89)	0.26
Postoperative ASES 1 year	88.52 ± 1.29 (86-91)	88.65 ± 1.61(85-92)	0.77
Postoperative ASES 2 years	89.86 ± 1.28 (88-92)	90.35 ± 1.82 (90-94)	0.31
VAS Mean ± SD, (range)			
Preoperative VAS	4.95 ± 0.86 (4-6)	4.91 ± 0.79 (4-6)	0.88
Postoperative VAS 6 months	2.9 ± 0.77 (2-4)	2.78 ± 0.67 (2-4)	0.58
Postoperative VAS 1 year	1.71 ± 0.64 (1-3)	1.52 ± 0.67 (1-3)	0.34
Postoperative VAS 2 years	0.95 ± 0.74 (0-2)	0.96 ± 0.71 (0-2)	0.99
Number of used anchors	1.48 ± 0.51	3.48 ± 0.51	<0.001

SD: standard deviation; ASES: American shoulder and elbow surgeons score; VAS: visual analogue scale; MMA: Modified Mason-Allen.; DR: Double row; n: number of patients.

There was no statistical correlation between the pre-operative Snyder classification and the VAS, ASES and Constant scoring system at 2 years follow up.

Discussion

The goal of RC repair surgery is to ensure secure tendon fixation sufficient to keep the repaired tendon in the prepared footprint until biological healing occurs [1].

Hence various factors may be involved in the high rates of re-tears including, the severity of the tear [15], tendon and bone quality [16] and muscle atrophy and fatty degeneration [13,14], repair techniques have been progressed to enhance the biomechanical features of rotator cuff repair.

Controversy exists regarding single row versus double row techniques with little evidence of better clinical outcomes with the latter technique [17].

In our study, no statistically significant differences were detected in the functional outcomes between the modified Mason-Allen versus the double row suture bridge repair techniques.

This may be attributed to the fact that, Modified Mason-Allen suturing technique used in rotator cuff repair has superior mechanical properties than other simple and mattress stitches, and merging the mattress and vertical stitch results in a stable and balanced contact pressure between the tendon and the footprint with distributed tension on the repaired tendon [18,19].

Our results are in line with Gerhardt et al. [20] who showed that modified Mason-Allen repair technique for RC tears using a double loaded suture anchor results in similar clinical results with those of double row suture-bridge technique.

Also, Lichtenberg et al. [21] proved that significant improvement of the Constant scores of all patients were found after using the modified Mason-Allen technique in RC repair, and similar rates of re-tear were found when compared with the mini-open repair technique.

Baums et al. [22] compared the tendon-bone interface contact pressures of various single versus double row suture anchor repair techniques, and proved that the average contact pressures for the modified Mason-Allen stitches and double row techniques were greater than those of other techniques using simple stitches.

Although the DR repair technique has biomechanical advantages and aims at reestablishment of a bigger medial to lateral footprint area with increased initial strength and smaller gap formation as compared with single row [22], some studies have reported failure at the medial row at the musculotendinous junction, which is very hard to revise [23].

In addition, the DR technique is criticized for being a longer and more complex surgical procedure than the single row technique. Also, the application of more implants with higher cost without adding any major clinical advantage over single row, and the presence excess implants at the footprint which render the repair of re-tears more difficult [24-26].

Furthermore, in our study the modified Mason-Allen repair technique proved to be economically more beneficial as there was a statistically significant less number of used suture anchors than the DR suture bridge technique. A great concern should be paid towards the economic benefits while comparing two different rotator cuff repair techniques, especially when clinical outcomes are similar.

Our study has some limitations. First, the relatively small number of patients included in each group. Second, treatment of concomitant pathologies with rotator cuff repair like biceps tendon tenotomy or tenodesis. Although, we believe that the treatment of these pathologies had no influence on the current results as they were not the prime reason for the symptoms in patients with rotator cuff tear. Finally, our study lacked radiographic assessment of the structural integrity of the repaired rotator cuff tendons.

Conclusion

The clinical results following the modified Mason-Allen repair technique were comparable to those of the double row suture bridge repair technique which required more anchors with higher cost. Therefore, the modified Mason-Allen single row repair technique can be considered a reliable, simple and less costing method for treatment of patients with rotator cuff tears.

References

1. Burkhart SS. Arthroscopic rotator cuff repair: indications and techniques. Oper Tech Sports Med. 1997; 5:204-214.
2. Lafosse L, Brozska R, Toussaint B, Gobezie R. The outcome and structural integrity of arthroscopic rotator cuff repair with use of the double-row suture anchor technique. J Bone Joint Surg Am. 2007; 89:1533-1541.
3. Lo IK, Burkhart SS. Double-row arthroscopic rotator cuff repair: reestablishing the footprint of the rotator cuff. Arthroscopy. 2003; 19:1035-1042.

4. Severud EL, Ruotolo C, Abbott DD, et al. All-arthroscopic versus mini-open rotator cuff repair: A long-term retrospective outcome comparison. Arthroscopy. 2003; 19:234–238.
5. Bishop J, Klepps S, Lo IK, et al. Cuff integrity after arthroscopic versus open rotator cuff repair: a prospective study. J Shoulder Elbow Surg. 2006; 15:290–299.
6. Boileau P, Brassart N, Watkinson DJ, et al. Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal? J Bone Joint Surg Am. 2005; 87:1229–1240.
7. Millett PJ, Mazzocca A, Guanche CA. Mattress double anchor footprint repair: a novel, arthroscopic rotator cuff repair technique. Arthroscopy. 2004; 20:875–879.
8. Fealy S, Kingham TP, Altchek DW. Mini-open rotator cuff repair using a two-row fixation technique: outcomes analysis in patients with small, moderate, and large rotator cuff tears. Arthroscopy. 2002; 18:665–670.
9. Galatz LM, Ball CM, Teefey SA, et al. The outcome and repair integrity of completely arthroscopically repaired large and massive rotator cuff tears. J Bone Joint Surg Am. 2004;86-A:219–224.
10. Demirhan M, Atalar AC, Kilicoglu O. Primary fixation strength of rotator cuff repair techniques: a comparative study. Arthroscopy. 2003; 19:572–576.
11. Scheibel MT, Habermeyer P. A modified Mason-Allen technique for rotator cuff repair using suture anchors. Arthroscopy. 2003;19(3):330-333.
12. Snyder SJ Arthroscopic classification of rotator cuff lesions and surgical decision making. In: Snyder SJ (ed) Shoulder arthroscopy. Lippincott Williams & Wilkins, Philadelphia, 2003. pp 201–207.
13. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. Clin Orthop Relat Res. 1994; 304:78-83.
14. Goutallier D, Postel JM, Gleyze P, et al. Influence of cuff muscle fatty degeneration on anatomic and functional outcomes after simple suture of full-thickness tears. J Shoulder Elbow Surg. 2003; 12:550-554.
15. Huijsmans PE, Pritchard MP, Berghs BM, van Rooyen KS, Wallace AL, de Beer JF. Arthroscopic rotator cuff repair with double-row fixation. J Bone Joint Surg Am. 2007; 89:1248-1257.
16. Nho SJ, Yadav H, Shindle MK, Macgillivray JD. Rotator cuff degeneration: etiology and pathogenesis. Am J Sports Med. 2008; 36:987-993.
17. Xu C, Zhao J, Li D. Meta-analysis comparing single-row and double row repair techniques in the arthroscopic treatment of rotator cuff tears. J Shoulder Elbow Surg. 2014;23(2):182-188.
18. Ma CB, MacGillivray JD, Clabeaux J, et al. Biomechanical evaluation of arthroscopic rotator cuff stitches. J Bone Joint Surg Am. 2004;86-A:1211–1216.
19. Barber FA, Herbert MA, Schroeder FA, Aziz-Jacobo J, Mays MM, Rapley JH. Biomechanical advantages of triple-loaded suture anchors compared with double-row rotator cuff repairs. Arthroscopy. 2010;26(3):316-323.
20. Gerhardt C, Hug K, Pauly S, Marnitz T, Scheibel M. Arthroscopic single-row modified Mason-Allen repair versus double-row suture bridge reconstruction for supraspinatus tendon tears: a matched pair analysis. Am J Sports Med. 2012;40(12):2777-2785.
21. Lichtenberg S, Liem D, Magosch P, Habermeyer P. Influence of tendon healing after arthroscopic rotator cuff repair on clinical outcome using single-row Mason-Allen suture technique: a prospective, MRI controlled study. Knee Surg Sports Traumatol Arthrosc. 2006;14(11):1200-1206.
22. Baums MH, Spahn G, Steckel H, Fischer A, Schultz W, Klinger HM. Comparative evaluation of the tendon-bone interface contact pressure in different single- versus double-row suture anchor repair techniques. Knee Surgery, Sport Traumatol Arthrosc. 2009;17(12):1466-1472.
23. Trantalis JN, Boorman RS, Pletsch K, Lo IKY. Medial rotator cuff failure after arthroscopic double-row rotator cuff repair. Arthroscopy 2008; 24:727-731.
24. Aydin N, Kocaoglu B, Guven O. Single-row versus double-row arthroscopic rotator cuff repair in small- to medium-sized tears. J Shoulder Elb Surg. 2010;19(5):722-725.
25. Koh KH, Kang KC, Lim TK, Shon MS, Yoo JC. Prospective randomized clinical trial of single-versus double-row suture anchor repair in 2-to 4-cm rotator cuff tears: clinical and magnetic resonance imaging results. Arthrosc J Arthrosc Relat Surg. 2011;27(4):453-462.
26. Saridakis P, Jones G. Outcomes of single-row and double-row arthroscopic rotator cuff repair: a systematic review. J Bone Joint Surg Am. 2010;92(3):732-742.