Comparative study between double-row suture and modified Mason-Allen suture bridge in rotator cuff repair: a prospective clinical study

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Background
Rotator cuff lesions are one of the causes of shoulder pain. Surgical treatment has been increasingly indicated.
Purpose
The aim of this work is to compare the clinical outcome and tendon healing after arthroscopic rotator cuff repair either by modified Mason-Allen suture bridge technique or double-row suture stitch technique.
Patients and methods
During the period between August 2021 and July 2022, a prospective clinical study was conducted involving 20 patients with symptomatic rotator cuff tear, who underwent arthroscopic repair. These patients were managed by the modified Mason-Allen suture bridge technique and double-row suture. This study conducted in the Benha University Hospitals, Nasr City Insurance Hospital and the military production hospital.
Results
The current study revealed no statistically significant difference between groups according to demographic factors such as age, sex and side, with *P* value more than 0.05. There was statistically significant higher change in group A: modified Mason-Allen suture bridge compared with group B: double-row according to constant score, with *P* value less than 0.05 (significant).
Conclusion
This study proved that there is statistically significant difference between the modified Mason-Allen suture bridge technique versus double row in functional outcome and integrity of rotator cuff tendon healing with relative advantage to the modified Mason-Allen suture bridge technique.

Keywords:
double-row suture, modified Mason-Allen suture bridge, rotator cuff repair

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Introduction

Rotator cuff lesions are one of the causes of shoulder pain and a frequent motive of medical consultations. These lesions can occur in any age group and appear in different forms, from tendinitis to rotator cuff arthropathy. The surgical or conservative treatment is defined according to the type of lesion (partial or complete) and is based on factors such as age, clinical condition, and pain and joint dysfunction. Surgical treatment has been increasingly indicated, with the arthroscopic repair being the most common procedure in recent years [1].

The aim of this work is to compare the clinical outcome and tendon healing after arthroscopic rotator cuff repair either by the modified Mason-Allen suture bridge technique or the double row suture technique.

Patients and methods

This prospective comparative study was conducted to evaluate the outcomes of treating symptomatic rotator cuff tear in 20 cases following arthroscopic repair with the modified Mason-Allen suture bridge technique (group A: 10 cases and double-row suture and group B: 10 cases).

This study was conducted in Benha University Hospital, Military Production Hospital, and Nasr City Insurance Hospital during the period between August 2021 an July 2022.

All selected patients met the following.

Inclusion criteria

(1) Age group: between 25 and 70 years.

(2) Sex: both sexes.
(3) Partial and complete rotator cuff tears.

Exclusion criteria

(1) Age group: below 25 and above 70 years.
(2) Shoulder instability.
(3) Bankart lesion.
(4) SLAP lesion.
(5) Patients with arthritis.
(6) Patient who will not complete a minimum follow-up of 6 months.

All patients provide their written consent to participate in study, and the study was approved by ethics commitee faculty of medicine Banha university.

Patient demographics

(1) Age, sex, and side:

The study was conducted on an age group ranging from 40 to 70 years (mean age of 50.73 ± 6.68 years). There was female predominance with female-to-male ratio of about 4 : 1. There were eight (40%) patients of 40–50 years and 12 (60%) patients more than 50–60 years among the age group.

There were six (30%) patients who had left-sided rotator cuff tear and 14 (70%) patients had right sided.

Methodology

History taking

(1) Personal data: name, age, sex, address, phone number, occupation, hand dominance, medical history, and medical habits.
(2) Data of the pathology: onset of complain, duration of symptoms, medication received for treatment, any history either for direct or indirect shoulder trauma.

Physical examination

(1) General examination: the patients were fully examined systemically for any other disease.
(2) Local examination: complete shoulder assessment was done with special attention toward impingement tests, test for rotator cuffs tear, and range of motion of the affected shoulder.
(3) Score systems for evaluation: preoperative scores.

CONSTANT score

The Constant-Murley score is a 100-point scale composed of a number of individual parameters. These parameters define the level of pain and the ability to carry out normal daily activities of the patient [2].

The Constant-Murley score was introduced to determine the functionality after the treatment of a shoulder injury.

The test is divided into four subscales: pain (15 points), activities of daily living (20 points), strength (25 points), and range of motion: forward elevation, external rotation, abduction, and internal rotation of the shoulder (40 points). The higher the score, the higher the quality of the function [3].

Subjective findings (severity of pain, activities of daily living, and working in different positions) of the participants are responsible for 35 points and objective measurements (AROM without pain, measurements exo and endo rotation via reference points and measuring muscle strength) are responsible for the remaining 65 points [4].

The Constant-Murley score is used in almost every language without official translations. In French a validated translation has been published. Time needed to complete the Constant-Murley test is between 5 and 7 min.

Radiographic evaluation

Radiograph

Radiographs were taken including: standard anteroposterior view, and lateral scapular view was done to all patients for the detection of bony changes associated with RCT, AC joint OA and to exclude another pathology.

MRI

MRI was done for all patients for tear identification; oblique coronal and oblique sagittal fluid-sensitive sequences were evaluated for the presence of RCT, with special care toward the presence of muscle retraction, muscle atrophy, and grading of fatty infiltration according to Goutallier [5].

Management

Preoperative measures

(1) Consent obtained from all patients.
(2) Routine preoperative laboratory tests were done.
(3) Broad-spectrum antibiotic was given 1-h preoperatively to all patients.

Intraoperative management

(1) Position: all patients were operated in beach chair position.
(2) Anesthesia: all operations were done under general anesthesia.

Technique: 1. Modified Masson-Allen suture bridge [6]

Four portals were typically required for Mason-Allen suture bridge repair: posterior and posterolateral portals (viewing portals) were used mainly for the standard 30° angled 4-mm arthroscope, while anterosuperior and lateral portals (working portals) were used for the instruments. After finishing subacromial decompression, release of the cuff, and tissue preparation, the posterolateral portal was used as a viewing portal for the 'Grand Canyon' view.

Double-row technique

Diagnostic arthroscopy is performed from the posterior portal with an arthroscopic pump, maintaining 60 mmHg pressure. Subacromial decompression, rotator cuff margin debridement, and bone bed preparation are completed. Medial to lateral and anterior to posterior mobility of the rotator cuff tear margins are evaluated, and the rotator cuff tear is classified. If the rotator cuff margin demonstrates excursion to the lateral aspect of the bone bed, then it is amenable for double-row repair.

Statistical analysis

Recorded data were analyzed using the Statistical Package for the Social Sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were presented as mean±SD and ranges. Also, qualitative variables were presented as number and percentages.

The following tests were done:

(1) Independent samples *t* test of significance was used when comparing between two means.
(2) Mann–Whitney *U* test: for two-group comparisons in nonparametric data.
(3) The comparison between groups with qualitative data was done using the χ^2 test.
(4) The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the *P* value was considered significant as the following:
   (a) *P* value less than or equal to 0.05 was considered significant.
   (b) *P* value less than or equal to 0.001 was considered as highly significant.
   (c) *P* value more than 0.05 was considered insignificant.

Case 1

Intraoperative data

(1) Complete rotator cuff tear retracted to the head of the humerus; release and repair were done by the modified Mason-Allen suture bridge technique.
(2) Subacromial decompression was done.

ROM

	Right shoulder	Left shoulder
Forward flexion	160°	160°
External rotation adduction	85°	85°
External rotation abduction	85°	90°
Internal rotation adduction	T12	T7
Internal rotation abduction	80°	90°
Abduction	175°	180°

Functional outcomes:

	Pre	Post
Constant	31	98
ASES	15	98.33

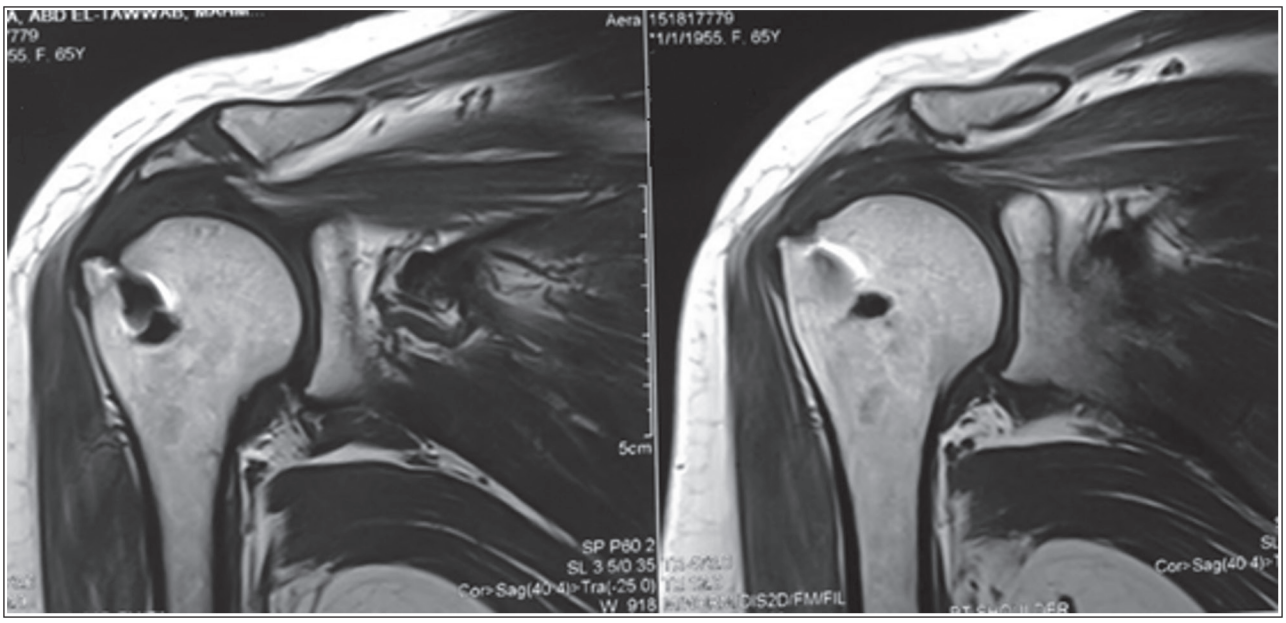
Fig. 1 Postopertive follow-up:

MRI: show complete healing of rotator cuff tendon healed by Sugaya's type 1 (Fig. 2).

Figure 1

Photographic imaging show postoperative active range of motion.

Figure 2



MRI right shoulder coronal cuts show healed tendon Sugaya type 1.

(1) Sugaya's classification: type 1.

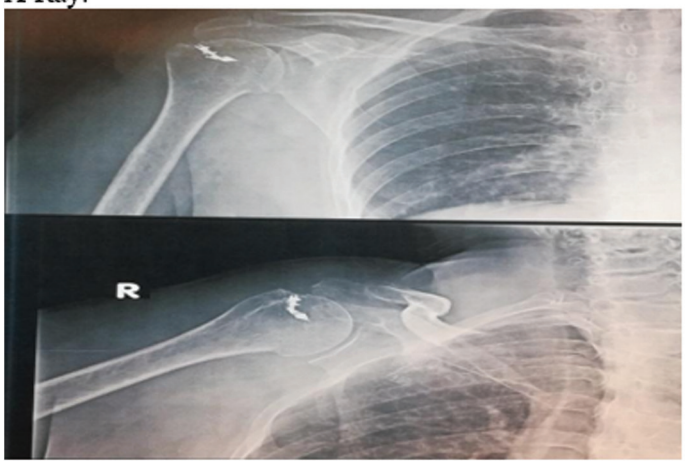
Case 2 (group B double-row stitch)
ROM

1-ROM

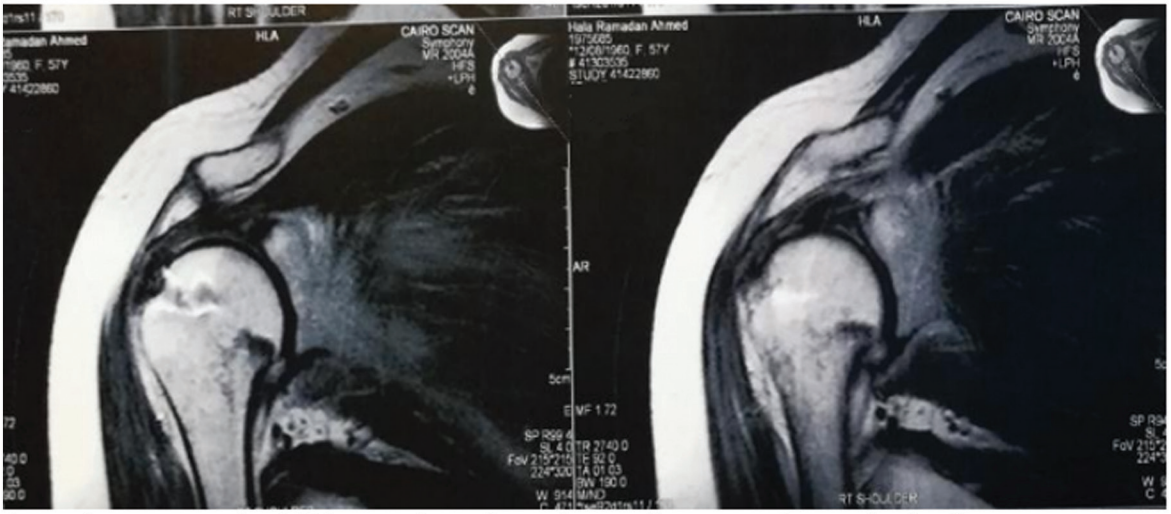
ROM	Preoperative	postoperative
Forward flexion	45	135
Abduction	45	135
ER(at abduction 90)	30/90	60/90
IR	lateral thigh	lateral thigh

Postopertive follow-up:
Radiograph

POST OPERTIVE FOLLOW UP:
X-Ray:



Post MRI :



6 months postoperative MRI coronal cut show picture of postoperative tendon healing.

Table 1 Comparison between group A (modified Mason-Allen suture bridge) and group B (double-row) according to demographic data

Demographic data	Group A: modified Mason-Allen suture bridge (*N*=10)	Group B: double row (*n*=10)	Test value	*P* value
Age (years)				
Mean±SD	53.40±7.07	55.80±6.46	t=0.628	0.439
Range	40–60	43–60		
Sex [n (%)]				
Female	8 (80.0)	8 (80.0)	χ2=0.000	1.000
Male	2 (20.0)	2 (20.0)		
Side [n (%)]				
Left	4 (40.0)	3 (30.0)	χ2=0.220	0.639
Right	6 (60.0)	7 (70.0)		

t, independent sample *t* test; χ^2, χ^2 test.
P value more than 0.05 (nonsignificant).

Table 2 Comparison between group A (modified Mason-Allen suture bridge) and group B: (double row) according to CONSTANT score

CONSTANT score	Group A: modified Masson-Allen suture bridge (*N*=10)	Group B: double row (*N*=10)	*U* test value	*P* value
CONSTANT score pre				
Mean±SD	34.70±7.48	36.00±12.47	-0.303	0.762
Range	22–45	22–59		
CONSTANT score post				
Mean±SD	83.60±7.97	72.10±8.18	-2.577	0.010*
Range	70–98	61–87		
Mean difference				
Mean±SD	48.90±9.88	36.10±15.24	-2.329	0.016*
Change%				
Mean±SD	150.92±63.54	100.28±80.98	-2.191	0.027*

U, Mann–Whitney test.
P value more than 0.05 (nonsignificant).
**P* value less than 0.05 (significant).

Post-MRI:

Six-month postoperative MRI coronal cut show picture of postoperative tendon healing.

Results

Tables 1 and 2 show no statistically significant difference between groups according to demographic factors such as age, sex and side, with *P* value more than 0.05.

Discussion

Rotator cuff lesions are one of the causes of shoulder pain and a frequent motive of medical consultations. The study was conducted on a wide age group ranging from 25 to 70 years, (mean age, 50.73±6.68 years). There was female predominance with a female to male ratio of about 4 : 1. There were eight (40%) patients of 40–50 years and 12 (60%) patients of 51–60 years among the age group.

There were eight (40%) patients with no co-morbidities and 12 (60%) patients were with comorbidity. Out of them, four patients were hypertensive three patients were diabetic; one patient out had ischemic heart disease; one patient was asthmatic; one patient was hypothyroid; one patient had sarcoidosis and one patient had total thyroidectomy.

Statistically significant higher change in group A: modified Mason-Allen suture bridge compared with group B: double-row according to constant score with *P* value less than 0.05 significant.

Constant score improved in group A from (mean=34.70 ± 7.48) preoperatively to (mean=83.60 ± 7.97) postoperatively, and group B from preoperatively (mean=36.00 ± 12.47) to postoperatively (mean=72.10 ± 8.18).

In an effort to prevent retears, arthroscopic instruments and operative techniques have changed with time. One of the changes is the introduction of the concept of footprint reconstruction, which resulted in the use of double-row repair that provided a wider interface between the tendon and the original footprint of the humeral head [7]. More recently, a suture bridge repair technique has received great attention [7]. Some studies have shown superior biomechanical characteristics with a suture bridge repair when compared with a double-row repair. In addition, a suture bridge repair reconstructs the footprint of the rotator cuff better than a double-row repair [8].

In single row repair model, tissue holding is a major concern because most retears occur through poor quality cuff tissue that has poor suture-holding properties. Based on 22 revisions of open suture anchor rotator cuff repairs, Cummins and Murrell [9] described that the predominant mode of failure was the suture pulling through the tendon. When using a standard method of suture bridge technique, the medial row suture is generally tied in a horizontal mattress configuration. The suture limbs are then used to create suture bridges over the tendon. Suture bridge repair relies on the medial tendon for fixation. Park *et al.* [7] believed that the medial suture passes take advantage of a healthier tendon for fixation strength, because the lateral tendon tissue is often compromised.

Several efforts have been made to improving tissue holding in the suture-bridge technique. Toussaint *et al.* [10] developed the 'modified lasso-loop stitch' in medal row repair. However, they advocate the lasso-stitch to be used for smaller tears because of the risk of premature failure of the weakest link in the tendon–suture interface. The loop stitch has significantly lower failure strength when compared with the modified Mason-Allen stitch, as well as horizontal mattress suture of the standard suture bridge technique [11].

Historically, many stitch methods have been proposed, such as Kleinert, Kessler, Mac or Bunnell, modified Mason-Allen stitch, etc. for tendon repair [10]. In a comparative study on the ultimate tensile strength of tendon-grasping techniques by Gerber *et al.* [11], the simple stitches and the mattress sutures slipped out at moderate loads, but the modified Mason-Allen stitch allowed the least gap formation and showed high ultimate tensile strength.

The Mason-Allen suture bridge technique has several advantages: (a) it has a very strong tissue-holding property; (b) it creates a rip stop that prevents tendon pull-out; (c) a possibility of strangulation of the rotator cuff tendon, impingement, or irritation that may be caused by the knot is low.

Conclusion

This study proved that there is statistically significant difference between the modified Mason-Allen suture bridge technique versus double raw in functional outcome and integrity of rotator cuff tendon healing with relative advantage to the modified Mason-Allen suture bridge technique.

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Nil.

Conflicts of interest

There are no conflicts of interest.-

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