Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology 22 (2020) 49–55

Contents lists available at ScienceDirect

Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology

journal homepage: www.ap-smart.com

Original Article

Arthroscopic Bankart repair: A matched cohort comparison of the modified Mason Allen method and the simple stitch method☆

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A R T I C L E I N F O

Article history:
Received 6 May 2020
Received in revised form
13 July 2020
Accepted 27 July 2020

Keywords:
Arthroscopic bankart repair
Modified Mason Allen stitch
Inferior capsular shift
Recurrent anterior shoulder dislocation

A B S T R A C T

Introduction: Arthroscopic Bankart repair (ABR) has become a standard treatment for recurrent anterior shoulder dislocation in cases with minimal bone loss. Using the standard Bankart repair technique, the failure rate has been reported to be approximately between 4 and 35%. In addition to the original injury, multiple pathologies can occur after a dislocation including a Bankart lesion, capsular redundancy and bone defects. In cases with no significant bone loss, soft tissue plays a major role in stabilizing the shoulder joint. We hypothesized that effective repair of soft tissue with good inferior capsular shifting and proper capsulolabral restoration can create a proper level of soft tissue tension so the horizontal mattress suture method should improve outcomes.
Materials and methods: A retrospective cohort study was conducted by reviewing the records of patients with recurrent anterior instability who underwent ABR at a single institution between January 2009 and December 2017. Demographic information, preoperative radiographic data including glenoid bone loss, Hill-Sachs width, glenoid track and other surgical details were retrieved from the medical records. The patients identified were divided into 2 groups. Group 1 had one modified Mason Allen stitch plus simple stitches, while Group 2 had only simple stitches. Data obtained from the patient included failure rate, patient satisfaction, the ROWE score and Walch-Duplay score at a minimum of 2 years after surgery. Risk factors for failure were also identified.
Results: Group 1 included 50 patients (mean age 27.2 ± 9.4 years) who underwent modified Mason Allen stitch ABR (median follow-up, 59.2 months; range, 26.2–128.6 months). Group 2 included 30 patients (mean age 26.9 ± 8.5 years) who underwent simple stitch repair ABR (median follow-up, 68.0 months; range, 24.0–127.9 months). All patients met the inclusion criteria. Evaluation at the final follow-up compared Group 1 and Group 2: ROWE score (86.8 vs 76.3, $P = 0.001$), Walch-Duplay score (87.2 vs 82.0, $P = 0.035$), respectively. Failure rates were 6% in group 1 compared to 10% in group 2 ($P = 0.511$).
Conclusions: The modified Mason Allen stitch technique and the simple stitches technique ABR both result in excellent patient satisfaction at a minimum 2-year follow-up. Both techniques successfully restore shoulder stability, but the modified Mason Allen stitch technique results in better functional outcomes.
Study design: Cohort study; level of evidence, 3.

Introduction

Recurrent anterior shoulder dislocation is a common injury in athletes. Conservative treatment generally yields poor results, especially in young, active athletes, with reported failure rates as high as 90%.[1] When conservative treatment is unsuccessful, surgical treatment becomes the primary option. Traditionally, open repair has been the gold standard for stabilization; however, with

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https://doi.org/10.1016/j.asmart.2020.07.004

innovations in implants, arthroscopic equipment and new surgical techniques, arthroscopic repair has become the preferred method due to the complications associated with open surgery such as longer operative time, greater blood loss, and motion loss due to damage to the subscapularis. To date, the results of treatment with open and arthroscopic repair techniques are comparable.[2] Although recurrent dislocation after surgical stabilization with those two methods is uncommon, when it does occur it can be problematic. Recurrence rates after arthroscopic Bankart repair (ABR) have been reported to be between 4 and 35%.[3]

Many factors contribute to the stability of the shoulder joint. Bone and soft tissue are the main structures providing stability for the shoulder joint. Due to the configuration of the glenoid, the bony component provides less constraint to the humeral head than the soft tissue.[4] Burkhart and De Beer[5] reported that in a group of patients with no bone loss, repairing capsulolabral tissue provided excellent results. The main contribution of tissue to stability comes from capsulolabral tissue which is firmly attached to the glenoid. With the proper tension, it serves as a checkrein ligament of the humeral head. When a shoulder dislocates, capsulolabral tissue is torn from the anteroinferior glenoid, a so-called “Bankart lesion”. This results in decreased labral height, laxity of the anterior band of the inferior glenohumeral ligament (AIGHL) and loss of the checkrein function.[6–8] Subsequent shoulder dislocations result in additional capsulolabral tissue stretching. Failure to properly address the pathology can result in an unsuccessful repair.[9]

There are currently many techniques to facilitate soft tissue repair including various suturing techniques and augmentation methods, e.g., horizontal mattress suture, vertical mattress suture and inferior capsular shift. Hagstrom and Marzo[10] conducted a cadaveric study analyzing the difference between vertical and horizontal suturing in restoring labral anatomy, and concluded that in vitro horizontal mattress suturing achieved better anatomical labral restoration. They postulated that in a clinical setting the modified Mason Allen stitch may increase stability of the capsulolabral tissue repair site. If this theory is accurate, the type of suturing may affect the success of the intervention. An in vitro study by Nho et al.[11] reported on the biomechanics of four different suture repair techniques: vertical mattress stitch, horizontal mattress stitch, double-loaded vertical stitch and knotless anchor. They concluded that these four repair techniques performed similarly in vitro. All repair stitches, including vertical, horizontal, and double loaded, performed similarly. These studies have had a significant impact; however, the amount of clinical evidence remains limited.

The aims of arthroscopic Bankart repair are to restore the native anatomy and tension properties of the capsulolabral tissue, to stabilize the glenohumeral joint and to prevent further episodes of dislocation.[12] The repair procedure should include reattachment of the labral tissue and tensioning of laxity of the anteroinferior capsule. Thus, restoring labral tissue height and shifting of the redundant capsule from the anteroinferior direction should be the final result.[13] Recently, the modified Mason Allen stitch has come into favor and has been theorized to be superior to the simple stitch technique.[9,14,15] The concept of combining capsular shift and arthroscopic Bankart repair (ABR) with the modified Mason Allen stitch technique has been challenged.[16] However, clinical studies are still sparse.

The purpose of our study was to compare clinical results and patient-reported outcomes (PROs) of a group of patients who underwent ABR with the modified Mason Allen stitch (1M2S-ABR) with a group who received only simple stitch ABR (3S-ABR). We hypothesized that the outcomes of ABR with the modified Mason Allen stitch technique would be comparable to the outcomes with the simple stitch technique.

Materials and Methods

This retrospective cohort study was performed at our institution after the approval was obtained from an institutional review board. The medical record database was queried for all patients who underwent ABR by one of three surgeons (C.P., P.W., and P.N.) between January 2009 and December 2017. Patients with at least a 2-year follow-up and who were able to be examined or interviewed were included. A total of 96 patients were initially identified for this study. Exclusion criteria consisted of revision ABR procedures, patients with MDI who required pancapsular plication, posterior Bankart lesions, and a lack of a minimum 2-year patient follow-up. (Fig. 1).

Operative records were manually reviewed to confirm the surgical technique performed. Data, including the repair technique, the operative time, the number of anchor fixation, and other intraoperative details such as concomitant procedures, were collected. The patients were assigned to 1 of 2 groups. In Group 1 the modified Mason Allen stitches were done by one of three surgeons and in Group 2 the simple stitches were done by the other two surgeons. Medical records of all patients were reviewed to obtain demographic characteristics, injury details, glenoid bone loss and Hills-Sachs width. We examined and interviewed patients for the final clinical outcomes using Rowe score and Walch-Duplay score.[17–20] When a face to face interview was not possible, patients were interviewed via telephone. Failure of the operation was defined as a recurrent dislocation and unsatisfactory results.

Surgical technique

All patients were operated on in the lateral decubitus position with the arm at 45° abduction and 20° forward flexion with 5-kg of traction. Three standard portals were used: posterior, anteroinferior and anterosuperior. The posterior portal was created first at the soft spot which usually located 3 cm inferior and 1 cm medial to the posterolateral corner of the acromion. After the posterior portal was created, the anteroinferior portal was initiated by piercing with a spinal needle and navigating to the proper position using the outside-in technique. Finally, the anterosuperior portal was created in the same way, i.e., by needle navigation. This portal was located in the rotator interval at the corner of the long head biceps and the glenoid bone. The only difference between the two groups was the suture configuration used.

Group 1: 1M2S-ABR

All the patients in this group were operated on by the same surgeon. The first suture anchor was always a double loaded suture placed at the 5.30 o’clock position. The anchor was consistently placed on to the glenoid surface approximately 2–3 mm from the cartilage margin. The camera was then moved to the anterosuperior portal. One limb of the suture was passed through the most inferior capsulolabral tissue. A curved 45°/90°needle, Spectrum hook (Conmed-Linvatec Inc., Largo, FL, USA) was used to pierce the capsule 1–1.5 cm at the 6 o’clock position of joint capsule in order to obtain a south-to-north capsular shift after tying the knot. The second limb from the same suture was passed through the tissue just beside the first limb to create a horizontal stitch pattern. The horizontal configuration was aligned in the direction of the AIGHL. Then the third limb from a different suture was stitched between the first two limbs. Knot tying was done first on the horizontal stitch and then the vertical stitch through the anteroinferior portal.

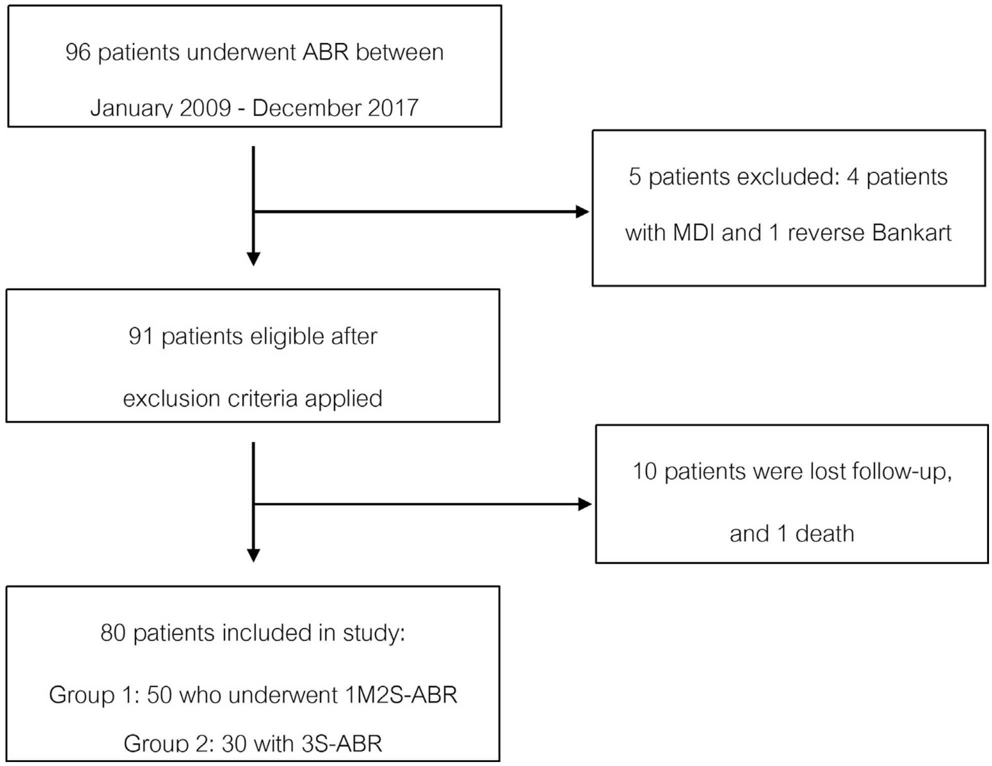

Fig. 1. Flow of patients through the study (ABR = arthroscopic Bankart repair, 1M2S = 1 modified Mason Allen stitch and 2 simple stitches, 3S = 3 simple stitches).

The modified Mason Allen stitches were performed first to ensure shift of the tissue. The simple stitches were done to create a bump of tissue. This created a crisscross configuration of the first anchor. Then the second and the third anchors were placed at the 4 and 3 o'clock position, respectively. For these last two anchors, a single loaded suture anchor was used. The first limb from the anchor was stitched through the anterior capsulolabral tissue and was later used as a post for knot tying. This was done to reduce the laxity of the anterior capsule and to create a bump of capsulolabral tissue to facilitate anterior labral repair and capsular retensioning. (Fig. 2.).

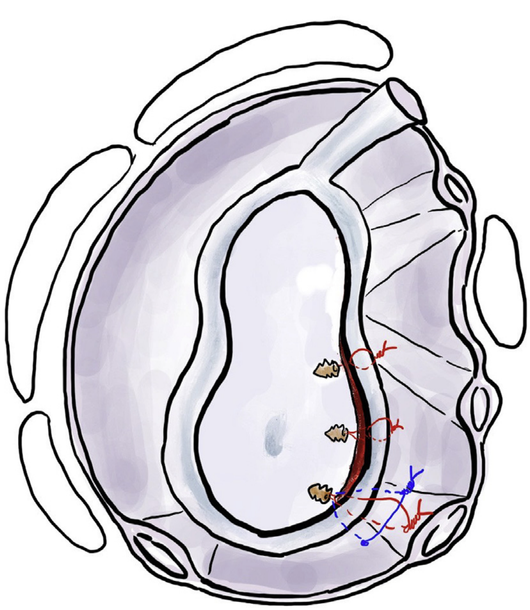

Fig. 2. Modified Mason Allen stitch ABR (1M2S-ABR).

Group 2: 2S-ABR

All the patients in this group were operated on by the other two surgeons. The preferred suture anchor for this group was the single loaded suture anchor. The first suture anchor was placed at the 5.30 o'clock position. The anchor was always placed on to the glenoid surface approximately 1–2 mm from the cartilage edge. The first limb from that anchor was stitched through the anterior capsulolabral tissue using a Spectrum hook. The limb that was passed through the tissue was later used as a post for knot tying. This was done to reduce the laxity of the anterior capsule and to create a bump of capsulolabral tissue. Then the second and the third anchors were placed at the 4 and 3 o'clock position, respectively. The capsulolabral tissue was stitched in the same fashion to facilitate anterior capsule repair and reconstruction. (Fig. 3.).

The patients were scheduled for regular follow-up sessions after their operation (on the 2nd, 4th week, 3rd, 6th, 12th and 24th month and beyond). During the final follow-up sessions, the patients were assessed both clinically and using the ROWE score and Walch-Duplay score. Clinical assessment consisted of evaluation of the clinical strength of the supraspinatus, range of motion and postoperative function of the operated shoulders. Assessment of the external rotation of the shoulder was performed with the patient's arm in adduction and in abduction.

All patients underwent a standard postoperative rehabilitation program, including placement of the operated shoulder in a sling and limiting active motion to no more than 30° of abduction and 30° of external rotation for 3 weeks. During this period isometric muscle strengthening exercises were conducted. After the 3 weeks, progressive passive range of motion exercises were done weekly for the next 3 weeks. Isometric rotator exercise continued to be emphasized during this period to prevent muscle atrophy. After the

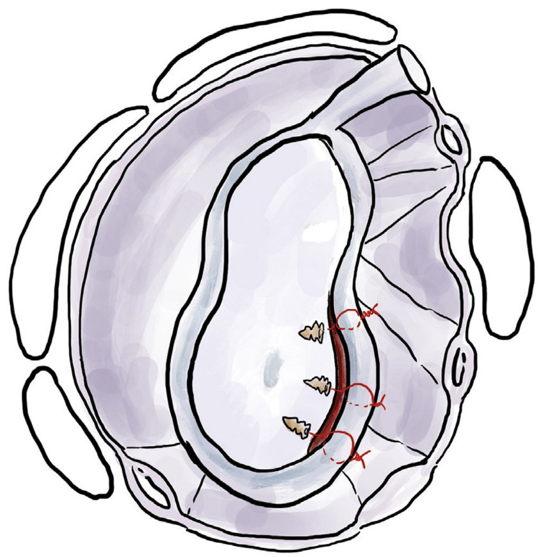

Fig. 3. Simple stitch ABR (3S-ABR).

6th week, patients were allowed to take off the arm sling. By the third month, patients should have full or nearly full range of motion. Beyond 3 months, progressive strengthening exercises were performed. We matched sport-specific training to the individual patient. After a 6-month period, the patients were allowed to return to their normal sports activities.

Statistical analysis

Patient characteristics, including demographics, age at first dislocation, number of dislocations, time from the first injury to surgery, radiographic findings such as the amount of glenoid bone loss, the Hill-Sachs width, patient-reported follow-up failures and final outcomes were summarized with descriptive statistics including mean, standard deviation, range, and percentage as appropriate. Hypothesis testing (Fisher exact test, Wilcoxon rank-sum test and Pearson chi-square test) were performed using JMP Pro 10.0.0 software to identify statistically significant differences in group demographics, failure rates, radiographic findings, and PROs as well as to compare results across surgical techniques and number of suture anchors. Kaplan-Meier survival analysis was used to compare time to failure between the groups. P values less than .05 were considered to be statistically significant.

Results

A total of 50 patients in the modified Mason Allen stitch ABR group and 30 patients in the simple stitch group had a minimum follow-up of 2 years and met all the inclusion criteria. The average age of the patients was 27.1 years (range 14–55) and 83.75% (67/80) were male. The average follow-up time was 67.65 months (range 24–128.61). Preoperative radiographic data, such as glenoid bone loss and Hills-Sachs width, were similar in both groups. Operative time was shorter and the number of anchor fixations was greater in the modified Mason Allen stitch ABR group than in the simple stitch group; both factors were statistically significant. (Table 1).

Three of the 50 patients (6%) in Group 1 (the modified Mason Allen stitch ABR group) and 3 of the 30 patients (10%) in Group 2 (the simple stitch group) experienced a failure ($P = 0.511$). Differences in failure rates between the two groups did not reach statistical significance, but all patients in both groups were satisfied with the results of the operation. (Table 2). Group 1 had a significantly higher average ROWE score and Walch-Duplay score at the latest follow-up than Group 2 ($P = 0.001$, $P = 0.035$). (Fig. 4).

The Kaplan-Meier Survival estimates comparing time to failure between the groups found a mean time to failure in Group 1 (the modified Mason Allen stitch group) of 47.0 ± 17.26 months and 21.21 ± 7.97 months in Group 2 (the simple stitch group). The failure rate was higher in Group 2, but the difference did not reach statistical significance (Fig. 5).

Discussion

The present study is a comparative analysis of groups of patients who underwent ABR by either the modified Mason Allen stitch method or the standard simple stitch technique. Both the modified Mason Allen stitch and the simple stitch ABR techniques resulted in successful restoration of shoulder stability, improved PROs and high satisfaction rates. Overall, the results were comparable to that reported in previous studies.[21,22]

With the current technology and surgical techniques, we found that the success rate of ABR is improving and is now comparable to open techniques. In the early period of ABR, there were reports of using different techniques including transglenoid suturing technique, staple capsulorrhaphy or older generations of suture anchors. After a period of learning and rapid innovation, ABR with suture anchors became a standard technique for treating recurrent anterior shoulder dislocation with no or minimal bone loss, showing the important function of soft tissue in stabilizing the shoulder. In the present study, the modified Mason Allen stitch technique had a lower failure rate 6% vs. 10% for the simple stitch technique, but the difference was not statistically significant. That may have been due to the relatively small number of cases (including the number of failures). The lower failure rate in the 1M2S-ABR group is probably related to differences in handling of the soft tissue. Speer et al.[23] reported that a Bankart lesion is not solely responsible for a dislocation. That means after an initial dislocation, other pathologies can occur in several locations. For example, the spectrum of capsulolabral injury can include detachment of the labrum from the glenoid bone, stretching of the capsule, a midsubstance capsular tear or a humeral avulsion of the glenohumeral ligament (HAGL). In most cases, there is a combination of Bankart lesion and stretching of the capsule. The soft tissue should be evaluated for possible pathologies that could affect the success of the operation.

In addition to using the modified Mason Allen stitch technique, we used a combination of other techniques such as placing the suture anchor at the 5.30 o'clock position on the glenoid face while the capsulolabral tissue was caught at the 6 o'clock position. After tying the knot, this method creates two effects: it results in both inferior shifting of the capsule as well as reduction of the joint volume. At this point in the operation, the repair site of the first anchors bears a higher load than the other anchors. Hagstrom and Marzo[10] reported an increase in stability using the horizontal mattress suture technique. That configuration also prevents the tied suture to pivot around the eyelet of the suture anchor. We believe that this effect cannot be adequately achieved using the conventional 3S-ABR technique. The rest of the anchors were placed at a higher position using the simple stitch technique. The function of the second and third anchors is mainly tensioning of the anterior capsule and restoration of labral height.

In our study, the overall failure rate was 7.5% (6/80). The modified Mason Allen stitch group had a longer average time to failure and all recurrences were caused by major traumatic events. In the simple stitch group, patients experienced feelings of instability from less traumatic events which might be the result of the

Table 1
Characteristics of the study groups.

Characteristics	Group 1: 1M2S-ABR (n = 50)	Group 2: 3S - ABR (n = 30)	*P*-value
Age (years) – Mean (SD)	27.2 (9.4)	26.9 (8.5)	0.902
Age of 1st time dislocation (year) – Mean (SD)	18.9 (6.5)	18.6 (3.7)	0.813
Sex – (% of male)	84.0	83.3	0.938
Number of dislocations – times (range)	17.0 (2–200)	19.6 (1–120)	0.396
Time from injury to surgery (month) – Median (range)	98.12 (2–444)	97.27 (12–420)	0.827
Duration of follow-up for patient-reported outcomes (months) – Median (range)	59.2 (26.2–128.6)	68.0 (24.0–127.9)	0.539
Glenoid bone loss % – Mean (SD)	16.2 (6.5)	16.6 (5.8)	0.788
Hills-Sachs width (mm.) – Mean (SD)	18.2 (3.7)	18.3 (4.3)	0.942
Operative time (minutes) – Mean (SD)	85.3 (23.0)	114.1 (35.0)	0.001*
Number of anchors (n) – Mean (SD)	3.32 (0.7)	2.97 (0.8)	0.040*

*Statistically significant difference between groups (P < 0.05).

Table 2
Patient-reported outcomes.

Patient-reported outcomes	Group 1 – Modified Mason Allen stitch ABR (n = 50)	Group 2 –Simple stitch ABR (n = 30)	*P*-value
Failure rate – n (%)	3 (6%)	3(10%)	0.511
ROWE score – Mean (range)	86.8 (50–100)	76.3 (50–100)	0.001*
Walch-Duplay score – Mean (range)	87.2 (65–100)	82.0 (55–100)	0.035*

*Statistically significant difference between groups (P < 0.05).

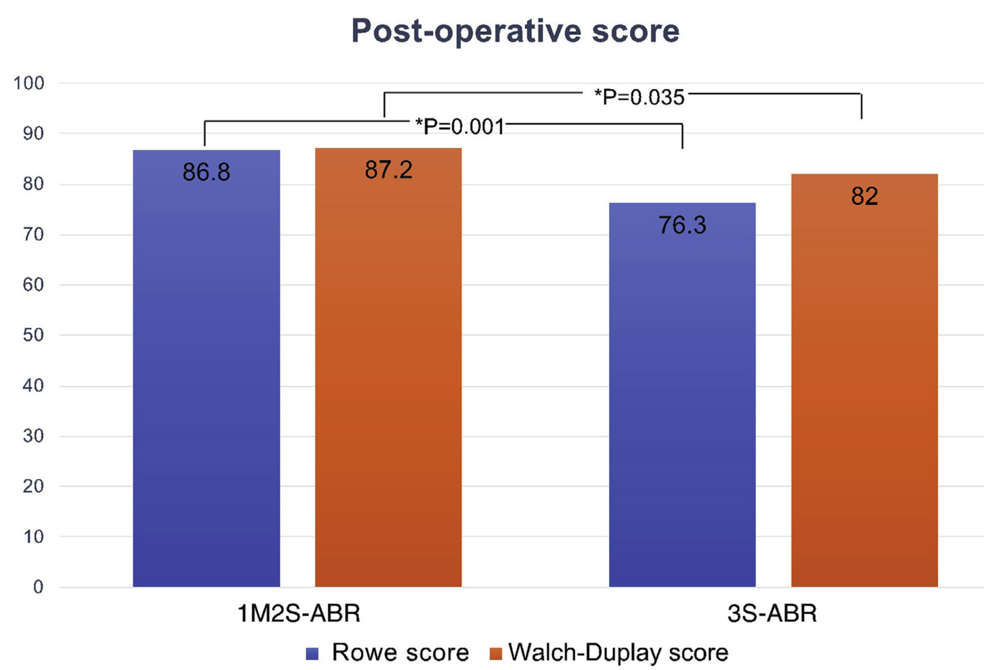

Fig. 4. Mean post-operative Rowe score and Walch-Duplay score of the modified Mason Allen stitch and simple stitch groups.

lower number of anchors. It is anticipated that with the use of the modified Mason Allen stitch technique in anteroinferior capsulolabral lesions, recurrence rates will be lower as the follow-up period increases.

The mean postoperative Rowe score in the 1M2S-ABR group was 86.8 (range, 50–100; SD, 11.9) and in the 3S-ABR group 76.3 (range, 50–100; SD, 14.5) (P = 0.01) indicating that patients in both groups were able to return to near their preinjury levels of activity, predominantly nonelite recreational and noncompetitive sports. The mean postoperative Walch-Duplay score was 87.2 (range, 65–100; SD, 9.3) in the 1M2S-ABR group and 82.0 (range 55–100; SD, 12.4) in the 3S-ABR group (P = 0.03), indicating that patients in both groups had little to no limitation on their daily or sporting activities and had minimal or no symptoms following surgery. Although the difference in Rowe and Walch-Duplay scores reached statistical significance, that is not likely to be clinically significant given the magnitude of mean scores in the two groups. The mean age of both groups is within that of a relatively active age group, so the difference in scores is not likely to have been confounded by patient age.

The findings of the present study are consistent with other studies, e.g., Lee at al.[14] reported on 76 patients who underwent arthroscopic Bankart repair augmented by plication of the IGHL via horizontal mattress suturing, stating that it is a viable alternative technique which gives improved clinical outcomes and a low recurrence rate.

Our study had some limitations. First, this was a retrospective analysis of clinical outcomes. Because of that, the number of

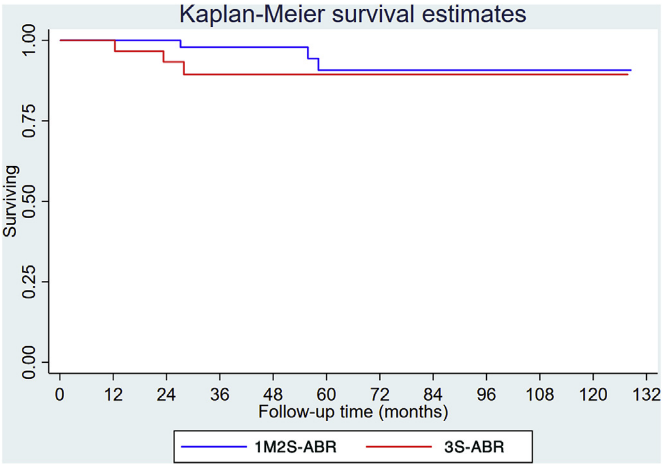

Fig. 5. Kaplan-Meier Survival estimates of time to failure in the modified Mason Allen stitch and simple stitch groups.

patients in one of the two groups was much larger than the other. To further validate the efficacy of this technique, randomized controlled studies are needed. Secondly, as the number of failed cases in this study was small, a study that includes a greater number of such cases may find differences between the two techniques.

In this study, we demonstrated that arthroscopic Bankart repair using plication of the IGHL via the modified Mason Allen stitch is a viable alternative technique that shows promise for improving outcomes. We conclude that this novel technique is a safe and reliable treatment option for shoulder instability, with clinical outcomes and recurrence rates comparable to the standard repair techniques.

Conclusions

The modified Mason Allen stitch for anteroinferior Bankart repair and the simple stitch ABR techniques result in excellent patient satisfaction and patient-reported outcomes at the 2-year follow-up and beyond. Both the modified Mason Allen stitch and the simple stitch techniques successfully restore shoulder stability and patient function, but the modified Mason Allen stitch technique results in better functional outcomes.

Ethics approval and consent to participate

Approval by the human ethical committee of Chiang Mai University No.ORT-2562-06720. Consent was waived as this is a retrospective analysis.

Funding

The authors received no financial support for the research, writing or publication of this article.

Authors' contributions

PS collected and analyzed the data and drafted the manuscript. PW and PN advised on the methodology and provided manuscript suggestions. DT drew the pictures. CP analyzed and interpreted the data and was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

The authors declare that they have no conflict of interest.

Acknowledgements

We wish to thank the Orthopaedics Department, Faculty of Medicine, Chiang Mai University, and Chiang Mai University Hospital for their kind support. We would also like to thank Ms. Areerak Phanphaisarn for the statistical analysis, Dr. Don Tharnphraisarn for the illustrative drawings and Dr. G. Lamar Robert for editing the English.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.asmart.2020.07.004.

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