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# Clinical and radiological outcome of arthroscopic Bankart repair in traumatic anterior glenohumeral instability with all-suture anchors

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## ABSTRACT

**Background:** Arthroscopic Bankart repair has evolved as an excellent treatment option in the management of recurrent shoulder instability as includes minimally invasive approach and significant reduction in perioperative morbidity. Anchor-related complications such as secondary cartilage damage and proud implant position are well described in literature. An all-suture anchor was developed and approved by the Food and Drug Administration in 2010. These anchors are placed into 1.4 mm diameter drilled holes which are smaller than the drill holes used for previously available anchor therefore minimize invasiveness and avoid complication related to metallic and bioabsorbable anchors. **Aims and Objectives:** This study to assess early radiological and clinical outcome after labral repair using all-suture anchors with specific consideration for bony reactions at the anchor site on magnetic resonance imaging. **Materials and Methods:** Twenty patients underwent labral repair using all-suture anchors were followed up for minimum of 1 year. Functional outcome was assessed on the basis of Rowe score, Constant and Murley score, and the American Shoulder and Elbow Surgeons score. The radiological appearance of bony reaction around the anchor site was judged by the presence of bony edema, tunnel widening (>3 mm), and cyst formation. **Results:** A total number of 56 all-suture anchors were implanted in 10 patients. The total Rowe score significantly improved from a mean of 24.4 preoperatively to 92.5 postoperatively. The American Shoulder and Elbow Surgeons score improved from a mean of 47.1 preoperatively to 88.6 postoperatively and the Constant and Murley score improved from a mean of 57.3 preoperatively to 90.6 postoperatively. On post-operative MRI out of 56 anchors implanted, 35 anchors did not display any reactive bone changes around anchor site. In 17 anchors, bone edema around a suture anchor was seen. Tunnel widening >3 mm was seen in four anchors. None of the anchors showed cyst formation around anchor site. **Conclusion**: Clinicoradiological outcome after arthroscopic shoulder instability using all-suture anchors was excellent at 1 year follow-up and radiological imaging revealed a good labral healing.

**Key words:** Anterior shoulder instability; Arthroscopic Bankart repair; All-suture anchor; Radiological outcome

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## INTRODUCTION

The evolution and advancement in arthroscopic techniques and instrumentation, better anatomical understanding and knowledge of the pathological of recurrent shoulder instability, greater experience among surgeons and with the emergence of suture anchors[1], Arthroscopic Bankart repair is now the most frequently used technique in surgical management of traumatic recurrent glenohumeral instability.[2] With increasing evidence in scientific literature

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revealing similar outcomes between patients undergoing open versus arthroscopic repair and with advantage of being a minimally invasive approach and allowance of detailed diagnosis of coexistent intra-articular shoulder pathology, there has been a shift toward using arthroscopic stabilization as the first line in surgical management in recent times.[3-5] The structure and composite nature of the glenoid anchors have significantly changes and improved with time. Metallic anchors which were initially used were associated with complications such as secondary cartilage damage and implant migration onto articular surface. The next-generation bioabsorbable anchors gave similar clinical results,[6] but associated with the complication like osteolysis in the glenoid bone.[7,8] This osteolysis decreases glenoid bone stock, thus increasing the recurrence rate,[7] post-age stamp like anterior glenoid rim fracture.[9] Newer generation all soft suture anchors are now being used in shoulder instability cases with possible advantage due to material properties, reduced bone resection due to smaller drill diameter and smaller anchor sizes compared to classical suture anchors and equivalent biomechanical strength in fixation.[10,11] However, the radiological and long-term clinical outcome of this implants is still unknown.

### Aims and objectives

The aim of this clinical study was to assess early radiological and clinical outcome after labral repair using all-suture anchors with specific consideration for bony reactions at the anchor site on magnetic resonance imaging (MRI).

## MATERIALS AND METHODS

### Eligibility criteria and pre-operative evaluation

The study was conducted after taking approval from the Institutional Ethical Board. The study type was interventional prospective clinical study. A consecutive series of 20 patients with traumatic recurrent anterior shoulder instability were treated by arthroscopic Bankart repair with all-suture anchors. All patients fulfilled patient criteria for arthroscopic Bankart repair at our institute. These criteria were as follows: (1) Patients experienced traumatic recurrent anterior shoulder instability; (2) the main pathologic lesion of anterior instability was recognized through arthroscopy as a Bankart lesion – not as a humeral side avulsion of the glenohumeral ligament; (3) patients did not have a severe bone defect at the anteroinferior (AI) glenoid of greater than 20% of the unaffected side as assessed preoperatively by non-contrast computed tomography (NCCT); (4) patients with on-track lesion; and (5) no tears of the superior labrum, the rotator cuff. A feeling of functional impairment in activities of daily living, as well as in sports participation, as a result of the injured shoulder led all patients to want a surgical intervention. Pre-operative evaluation included a detailed history of the patients about the cause of their initial dislocation, number of episodes of dislocation, and, furthermore, information about sports participation, whether professional or recreational was obtained. Physical examination included the anterior apprehension test, considered to be positive with true apprehension and not just pain, and testing of inferior laxity by sulcus sign.

All patients underwent pre-operative radiographs including anteroposterior, axial to assess any visible Hill-Sachs lesion, and loss of inferior glenoid contour to assess glenoid bony loss visible to plain radiograph and NCCT shoulder with 3D reconstruction to assess glenoid bony loss on glenoid face-off view using surface area method as devised by Sugaya et al., (Figure 1).[12]

Functional outcome was evaluated according to the shoulder rating scales of Rowe et al.,[13] Constant and Murley score,[14] and the American Shoulder and Elbow Surgeons score[15] preoperatively and postoperatively which were done 3 months, 6 months, and 12 months and then at yearly intervals after the operation.

At 12 months post-operative follow-up, all patients underwent state-of-the-art MRI utilizing a 1.5/3 Tesla high-field scanner including the standardized sequences T1, T2, and fat-suppressed T2 sections. The radiological appearance of bone reactions at the anchor site was judged as no changes (Grade 0); bone edema (Grade 1); tunnel widening of more than 3 mm (Grade 2); or cyst formation (Grade 3).[16]

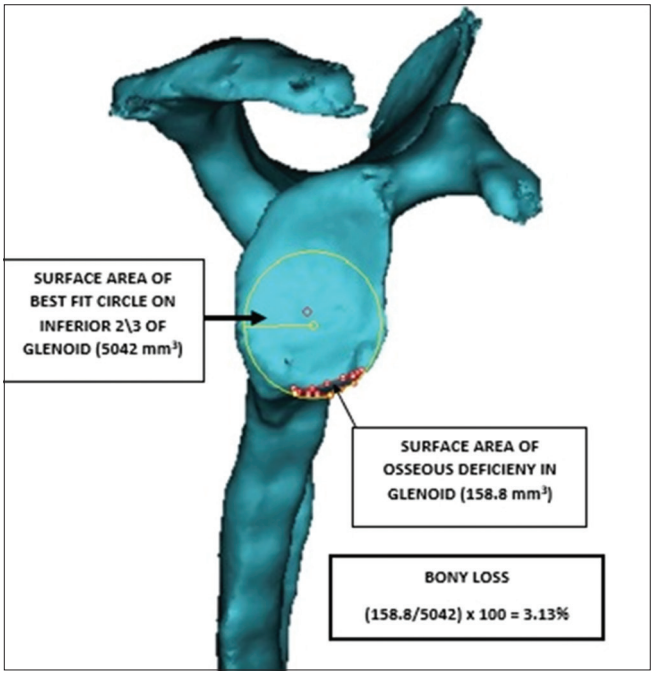


**Figure 1:** Calculation of glenoid bony loss using surface area method glenoid face-off view on 3D NCCT scan

### Operative procedure

Under general anesthesia, the patient was first clinically examined for instability. The patient was positioned in lateral decubitus with posterior tilt of 15° with the affected shoulder up and mounted to a shoulder traction unit in 45° abduction and 15° forward flexion. After proper cleaning and draping, the bony landmarks were marked. Standard posterior portal was established and a diagnostic round was performed. Then, anterosuperior (AS) and AI portals were established by outside in technique and two transparent ports were placed in them. The anterior labrum was released completely from the glenoid neck using tissue elevator down till 6 O' clock position on glenoid. The glenoid neck was prepared with a rasp and burr till bleeding bone is visible. Two or three anchors were all cases starting from the inferior most anchor being placed close to 5.30 O' clock position which is the most critical step. The drilling guide was inserted through AI portal and wedged on to glenoid neck surface junction and a 12 mm deep pilot hole will be made with a 1.4 mm or 2.3 mm using the drilling guide. The all-suture anchor was placed in the pilot hole and it was deployed by alternate milking of the sutures. Once the anchor is in place, one suture limb was retrieved through the AS portal. Adequate capsulolabral tissue bite was taken inferior to the placed anchor using an indirect suture passer with lasso. The lasso was taken out through AS portal and the suture parked there will be railroaded to come out through AI portal, thus passing the suture through capsulolabral tissue. A sliding knot or hangman knot was used to tie the capsulolabral tissue on the glenoid margin using a knot pusher. The knot was further secured with three alternate half hitches. These steps were repeated to place anchor at 4:30'o clock and 3'o clock positions. The aim of the procedure was to establish an adequate soft-tissue bumper on the anterior glenoid along with adequate retensioning of the capsule and superior capsular shift whenever required. Closure of the surgical incisions was done with single monofilament sutures.

### Post-operative management

Shoulders were immobilized for 2 weeks in a shoulder immobilizer in the internal rotation position. A sling was applied until 6 weeks postoperatively. Passive forward elevation exercises were begun at 2 weeks after surgery, passive external rotation exercise, started at 3 weeks, and muscle strength exercise first occurred at 6 weeks. Unrestricted activities of daily living were allowed at 3 months after the operation, and sports activity was permitted at 6 months after the operation.

### Statistical evaluation

Data analysis was performed using SPSS statistical software version 22 (IBM Corp., Armonk, New York, USA). Rowe score, Constant and Murley score, and the American Shoulder and Elbow Surgeons score were analyzed and results were expressed as mean with standard deviations. Student's t-test was employed to compare continuous variables that have normal distribution, while the Mann–Whitney U-test was used for variables with non-parametric distribution. Categorical variables are presented as proportions. The Chi-square test was used to compare categorical variables, as appropriate.

## RESULTS

All 20 patients were available for follow-up (mean 16 months, range 12–22 months). There were 18 male and 2 female patients with a mean age of 27.4±7.37 (SD) years. The mean number of dislocations before surgery was 4.2±2.43 (SD) with ranging from 3 to 8. Out of 20 patients, 15 (75%) patients were participating in some sort of sporting activity pre-surgery. Twelve patients (60%) were participating at recreational level, and 3 patients (15%) were participating at competitive level. Physical examination revealed a positive apprehension test in all patients and sulcus sign in 5 patients (15%). The demographic and clinical parameters are summarized in Table 1.

All the evaluated functional scoring systems revealed statistically significant improvement ($P<0.01$) in the status of the shoulder when pre-operative scores were compared with post-operative scores at the most recent follow-up. With the system of the American Shoulder and Elbow Surgeons, the mean score improved from 47.1±17.7 (SD) to 88.6±10.4 (SD) at the most recent follow-up; with the system of Constant and Murley, the mean score improved from 57.3±12.7 (SD) to 90.6±9.2 (SD); and the mean Rowe score improved from 24.4±9.2 (SD) to 92.5±14.2 (SD) (Table 2). The Rowe score was graded after considering stability, motion, and function. Accordingly, 16 patients (80%) had an excellent overall result and 4 (20%) had a good result.

**Table 1: Biostatistics and clinical assessment of patients who underwent arthroscopic Bankart repair**

| Variables | Number of patients |
|---|---|
| Gender | |
| Male | 18 |
| Female | 2 |
| Mean age | 27.4 (20–42) |
| Number of shoulders operated | 20 |
| Dominant side | 18 |
| Mean number of redislocations (range) | 4.2 (3–8) |
| Sports participation | |
| Recreational level | 12 |
| Competitive level | 3 |
| Anterior apprehension test | 20 |
| Sulcus sign | 3 |
| Mean duration of operative time (range) | 68.2 (55–130) min |
| Mean number of suture anchors (range) | 2.7 (2–3) |

In total, 56 all-suture anchors were implanted in 20 shoulders. The number and location of the anchors depended on the size and location of the labral tear. The implants did not hinder diagnostic MRI postoperatively. Thirty-five anchors (62.5%) did not display any reactive bone changes in response on anchor (Grade 0) (Figure 2). In the remaining 21 anchors, bone reactions around the anchors were seen. Bone edema around a suture anchor (Grade 1) (Figure 3) was seen in 17 anchors (30.35%). A Grade 2 reaction (tunnel widening > 3 mm) was seen in 4 anchors (7.14%) (Figure 4). None of the anchors showed Grade 3 (cyst formation around anchor site) (Table 3).

After a mean follow-up of 16 months, there were no reports of clinical failures (redislocation or subluxation). Of the 15 patients who participated in sports, 12 (80%) recovered enough function to be able to return to their premorbid level of competition.

## DISCUSSION

The most important finding of this study is that, when using all-suture anchors for labral repair during instability surgery, the development of higher grade (Grade 2 and above) in the glenoid bone is rare at 1-year follow-up. Most anchor site (62.5%) had no reaction around tunnel site and only 30.35% had minimal bony edema (Grade 1) around anchor site and only 7.14% anchors site had some tunnel widening (Grade 2). Larger cystic lesions (Grade 3) are probably rare (0% in this study).

Arthroscopic Bankart repair is considered by many surgeons as the procedure of choice in the management of recurrent shoulder instability without significant glenoid bone loss.[2,17] With the development of modern arthroscopic

**Table 2: Clinical shoulder scores showing significant improvements after arthroscopic Bankart repair**

| | Mean (SD) | | P-value |
|---|---|---|---|
| | Pre-operative | Post-operative | |
| Rowe score | 24.4 (9.2) | 92.5 (14.2) | <0.01 |
| American Shoulder and Elbow Surgeons | 47.1 (17.7) | 88.6 (10.4) | <0.01 |
| Constant and Murley | 57.3 (12.7) | 90.6 (9.2) | <0.01 |

**Table 3: Different grades of bone reaction and the associated number of anchors**

| | Grade 0 (no bone reaction) | Grade 1 (bone edema) | Grade 2 (tunnel widening) | Grade 3 (cyst formation) |
|---|---|---|---|---|
| Number of anchors (total=56) | 35 | 17 | 4 | 0 |

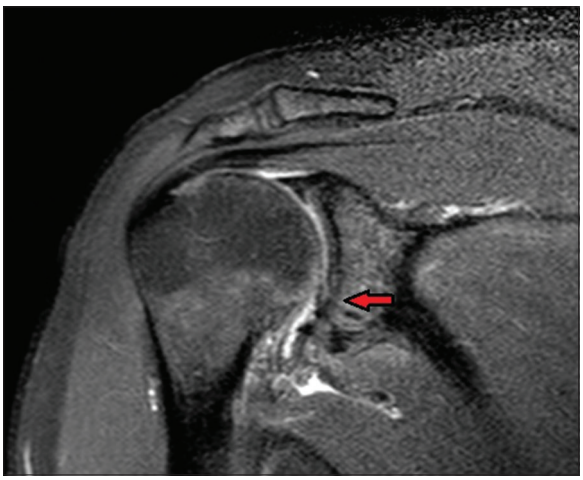

**Figure 2:** Oblique fat-suppressed T2 image of a right glenoid. The red arrow demonstrates the anchor site and there are no apparent bone reactions

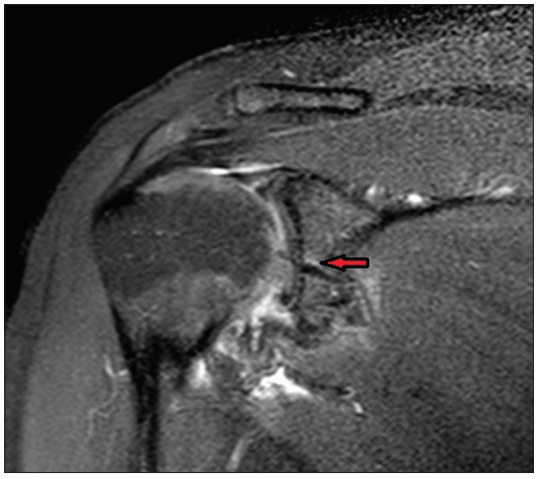

**Figure 3:** Oblique fat-suppressed T2 image of a right glenoid. The red arrow demonstrates edema around the anchor site

**Figure 4:** Oblique fat-suppressed T2 image of a right glenoid. The red arrow demonstrates tunnel widening around the anchor site

instrumentation and techniques, arthroscopic Bankart repair continues to evolve and improve, thus clinical and functional results of open versus arthroscopic Bankart repair technique are comparable in review literature.[3,4,5,18]

With the aim to produce similar functional outcome as of open Bankart procedure, Wolf et al.,[19] introduced an arthroscopic technique using suture anchors and showed promising results. With the use of different combinations of materials and suture implantation techniques, the choice of anchor used has evolved: Metallic, different bioabsorbable materials, or all-suture.

The composition of anchor plays a major role in clinical and functional outcome. Metallic anchors were associated with significant complications, related to long-term cartilage damage, and implant migration into chondral surface.[20] With the development bioabsorbable anchors which came with promise of resorption of anchor core in due time and replacement with bone at anchor site, the Clinical and functional outcome of both metallic and bioabsorbable anchors were comparable in literature.[6] Despite promising proposition and similar clinical results, absorbable anchors had their own complications. Müller et al.,[7] found that certain anchors developed cystic lesions due the inflammatory response to the absorbable material. Park et al.,[21] in his study on arthroscopic Bankart repair with absorbable anchors, showed significant osteolysis in 23% of cases on NCCT evaluation postoperatively. These osteolytic changes had also clinical implication as they were associated with glenoid rim fractures, a severe complication that develops in 1.6–6% of cases,[9] thus increasing the chance of recurrence.

An all-suture anchor developed and approved by the U.S. Food and Drug Administration for fixation of soft tissue to bone in 2010. These all-suture anchors are placed into smaller diameter (1.4 mm vs. 3 mm) drill holes into the glenoid rim, which are smaller than the drill holes used for classical metallic or bioabsorbable suture anchors and anchor devices, reducing the amount of native glenoid bone resection during anchor deployment.[22] There is decrease chance of hardware complications such as seen with metallic or bioabsorbable anchors due to their solid metallic or bioabsorbable core. The minimal invasive character of all-suture anchors does not come at strength of anchor. It is important to note that clinical and functional result of arthroscopic Bankart repair with all-suture anchor was similar to classical anchors as described in the literature.[23,24] Biomechanical studies have shown that the ultimate load-to-failure of soft-tissue anchors is comparable to standard solid anchors for labral repairs.[10] After a minimum follow-up of minimum 12 months, satisfactory clinical scores were obtained and there were no reports of recurrent instability.

### Limitations of the study

This study certainly has a number of weaknesses. First, it remains a relatively small non-randomized cohort of patients. This may result in a sampling error. Second, the follow-up period was still quite short, given that we know that results may deteriorate with time in patients with anterior shoulder instability repair. Third, we did not have a comparison group for labral repair with metallic or bioabsorbable anchors.

## CONCLUSION

We observed satisfying radiological and clinical outcomes after arthroscopic shoulder instability surgery with all-suture anchors. This study supports that, although some bone changes can occur, all-suture anchors can be used without undue concern for abnormal bone reactions and with good clinical results.

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**Authors Contribution:**
**VC-** Concept and design of the study, manuscript preparation, surgical intervention, and revision of manuscript; **VK-** Surgical intervention, interpreted the results, and reviewed the literature; and **PY-** Concept, coordination, statistical analysis and interpretation, and preparation of manuscript.

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