



# Arthroscopic glenoid labral lesion repair using all-suture anchor for traumatic anterior shoulder instability: short-term results

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**Background:** This study presents the preliminary clinical results of arthroscopic glenoid labral lesion repair using all-suture anchors in the treatment of recurrent traumatic anterior shoulder instability.

**Methods:** Seventy patients who underwent arthroscopic shoulder stabilization for traumatic anterior shoulder instability were evaluated in this single center–based retrospective study. Patients with a glenoid defect greater than 20%, off-track engaging Hills-Sachs lesion, multidirectional instability, and generalized ligamentous laxity were excluded. The 62 included patients treated with arthroscopic glenoid labral lesion repair using all-suture anchors were evaluated. The Rowe and Constant scores were used to assess the results.

**Results:** We evaluated 62 patients with a mean age of  $26.7 \pm 12$  years. The mean Rowe and Constant scores were  $35 \pm 7.2$  and  $65 \pm 6.3$ , respectively, preoperatively and increased to  $93.6 \pm 5.3$  and  $92 \pm 4.3$ , respectively, postoperatively at the mean follow-up of 28.8 months (range, 24–48 months) ( $P < .001$ ). The redislocation rate was 8.1%. Of the patients, 91.9% had good to excellent clinical scores. Younger age and contact sports were associated with a higher risk of recurrent dislocation ( $P = .012$  and  $P = .041$ , respectively). The postoperative functional results were not significantly correlated with the findings concerning the number of dislocations, time until surgery, degree of anterior translation, and number of anchors.

**Conclusion:** The use of all-suture anchors for arthroscopic glenoid labral lesion repair for the treatment of recurrent traumatic anterior shoulder instability yields satisfactory clinical results and is a safe and effective option.

**Level of evidence:** Level IV; Case Series; Treatment Study

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**Keywords:** Shoulder; instability; arthroscopic; Bankart; SLAP; all-suture anchor

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With developments in arthroscopic techniques and advanced implant options, arthroscopic surgery has become the primary treatment option for recurrent traumatic anterior shoulder instability, surpassing open surgery. Historically, the various arthroscopic procedures applied to treat this condition—including capsular stapling performed by Johnson<sup>12</sup> in 1980, the transosseous suture applied by

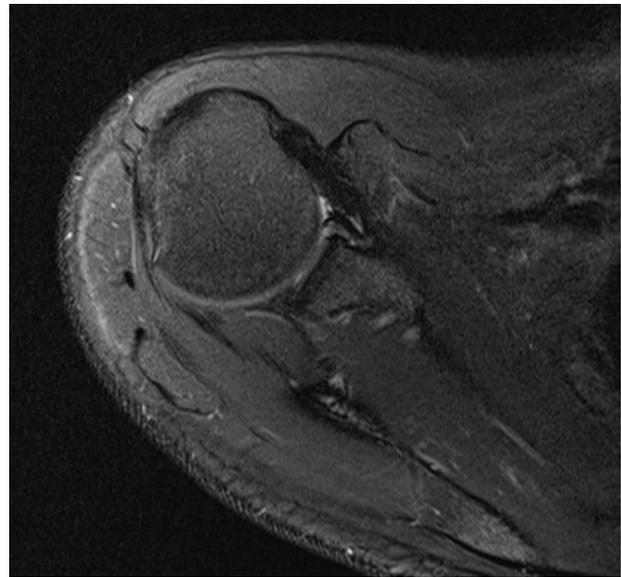
Morgan and Bodenstab<sup>18</sup> in 1987, and the metallic rivet applied by Wiley<sup>29</sup> in 1988—have all resulted in high recurrence rates. These high recurrence rates were blamed on the inadequacy of the implants and the surgical technique. The suture anchor method applied by Wolf<sup>31</sup> and Snyder and Strafford<sup>26</sup> in 1993 became a revolution in arthroscopic surgery with high success rates that are similar to those of open surgery. During this process, several pathoanatomic conditions, such as anterior labral periosteal sleeve avulsion (ALPSA),<sup>20</sup> glenolabral articular disruption (GLAD),<sup>21</sup> and Perthes lesions, as well as variations, such as the sublabral foramen and Buford complex,<sup>30</sup> have been defined. Subsequently, different implants have been developed to address the intraoperative and postoperative problems; medical and technical innovations have followed each other. Currently, there is a sizable amount of literature comparing the various suture anchor applications with arthroscopic surgery. Although the current literature identifies anatomic repair of the labral lesion as the ideal treatment for recurrent traumatic anterior shoulder instability, there is no gold standard for an ideal method or instrument. This is because of multiple reasons that are related to anchor design and material and often caused by the differences in surgical methods and preferences.

This study presents the clinical results of arthroscopic glenoid labral lesion repair using all-suture anchors in the treatment of recurrent traumatic anterior shoulder instability. The null hypothesis was that the all-suture anchors would be as reliable and effective as metal, bioabsorbable, and biostable anchors.

## Materials and methods

Seventy patients with traumatic anterior shoulder instability were treated with arthroscopic shoulder stabilization between 2014 and 2016. All procedures were performed by the senior author (O.G.). Eight patients were excluded from the study because of an accompanying glenoid defect greater than 20%, off-track engaging Hills-Sachs lesion, multidirectional instability, and generalized ligamentous laxity. These patients underwent the Bristow-Latarjet procedure, remplissage, or capsular shift for each associated condition, and their functional outcomes were excluded from the evaluation. The 62 included patients treated with arthroscopic glenoid labral lesion repair using all-suture anchors were evaluated.

Informed consent was obtained from all patients. Detailed anamnesis on how the first dislocation occurred, how many dislocations occurred, and how reduction was performed after these dislocations was obtained from the patients prior to surgery. A detailed physical examination of each patient was performed after anamnesis and included the amount of anterior translation of the shoulder, in addition to the anterior relocation and apprehension tests. The patients were evaluated for generalized ligamentous laxity with the Beighton criteria. The following factors were noted: age at primary injury and age at operation, interval between primary injury and operation, total dislocation events, and level of sport (contact, recreational, or none). Routinely, anteroposterior and axillary radiographs and magnetic resonance imaging (MRI)

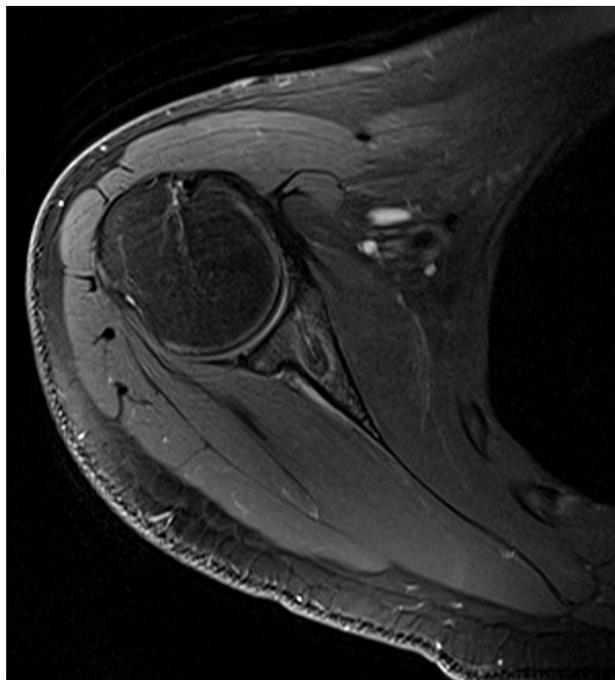


**Figure 1** Preoperative T2-weighted magnetic resonance image showing Bankart lesion.

of the shoulder were obtained in each patient prior to surgery (Fig. 1). These images were evaluated regarding the labral lesion of the glenoid cavity and bone defects in the glenoid cavity and humerus. Patients were evaluated using the preoperative and postoperative Rowe and Constant scores recorded during their preoperative physical examinations and postoperative follow-up appointments. The results of the Rowe score were categorized as follows: excellent, 90 to 100; good, 75 to 89; fair, 51 to 74; or poor, 50 or lower. The results of the Constant score were categorized as follows: excellent, 90 to 100; good, 80 to 89; fair, 70 to 79; or poor, 69 or lower. Redislocation was accepted as a failure criterion.

## Surgical technique

All patients were prepared under general anesthesia in the lateral decubitus position. Posterior, anterior, and anterolateral portals were established in a standard manner to allow access to the labral lesion. The glenoid and humeral articular surfaces; rotator interval; anterior, superior, and posterior labrum; superior, middle, and inferior glenohumeral ligaments; biceps and subscapularis tendons; and axillary pouch were evaluated with a 30° scope. The size of the Hill-Sachs lesion and labral tear was assessed with a 3-mm probe to measure the width, length, and depth using the clock-face method. The labral lesions were evaluated with a probe. The presence of the following lesions was determined and noted: Bankart lesion (detachment of the anteroinferior labrum with complete tearing of the scapular periosteum), Perthes lesion (detachment of the anteroinferior labrum with a medially stripped but intact periosteum), ALPSA (medially displaced labroligamentous complex with absence of the labrum on the glenoid rim), GLAD (partial tearing of the labrum associated with adjacent articular cartilage damage), bony Bankart lesion (Bankart lesion with an osseous fragment), and superior labral tear from anterior to posterior (SLAP). The labroligamentous complex was completely separated from the glenoid and mobilized superiorly



**Figure 2** Postoperative 1-year T2-weighted magnetic resonance image showing restored anterior labral height and anchor tracts with all-suture anchor.

and laterally using a rasp. In the cases with no glenoid defect, the anterior glenoid rim was decorticated using a burr. The glenoid rim was perforated at a 45° medial angle including 2 mm of the glenoid anterior lip at the 5:30–clock face position, and a 2.8-mm double-loaded all-suture anchor (Q-Fix [Smith & Nephew, Andover, MA, USA] or Juggernaut [Biomet, Warsaw, IN, USA]) was placed. Anchor threads were transferred and passed through the labroligamentous complex with a suture passer. Both sutures were tied through the anterior portal using sliding knots. Additional anchors were added at the 4- and 2-o'clock positions according to the size of the labral lesion. In the presence of a SLAP lesion, 1 more double-loaded all-suture anchor was placed in the supraglenoid tubercle and its threads were transferred and fixated at the posterior and anterior regions of the biceps anchor using the suture passer in the appropriate position.

All patients were kept in internal rotation with a Velpeau bandage for 4 weeks. Passive pendulum exercise was initiated on the first postoperative day. Physiotherapy was started at postoperative week 4. Strengthening exercises were initiated between the sixth and 10th weeks. Sporting activities were allowed after 6 months. Postoperative 1-year control MRI was performed (Fig. 2).

### Statistical analysis

Statistical analysis was performed using SPSS software (version 23.0; IBM, Armonk, NY, USA). A normal distribution was defined by the Kolmogorov-Smirnov test. Preoperative and postoperative comparisons were performed using the Mann-Whitney *U* test as quantitative data. The Wilcoxon test was used to compare the functional outcomes of subgroups. Power analysis was calculated

and showed 80% power with an  $\alpha$  value of .05 (95% confidence interval). All values are expressed as mean values.

### Results

This study included 62 patients (32 male and 30 female patients). The mean age of the patients at the time of surgery was  $26.7 \pm 8$  years (range, 17–41 years). The mean follow-up time was  $28.8 \pm 13$  months (range, 24–48 months). The mean time from the first dislocation to surgical treatment was  $12.3 \pm 6$  months (range, 4–36 months). The mean number of dislocations at presentation was  $4.5 \pm 1.93$  (range, 1–12). The mean number of anchors used was  $2.7 \pm 0.71$  (range, 2–4). All anchors were all-suture anchors and were double loaded. Examinations performed with patients under general anesthesia revealed grade 1 anterior translation (increased translation, no subluxation) in 26 patients (41%), grade 2 (subluxation of the humeral head to, but not over, the glenoid rim) in 20 patients (32%), and grade 3 (dislocation of the humeral head over the glenoid rim) in 16 patients (25%). Patients' demographic characteristics are shown in Table I.

Intraoperative examinations showed Bankart lesions in 27 patients (43.5%), ALPSA in 3 (4%), GLAD in 4 (6%), Perthes lesions in 3 (4%), and combined Bankart and SLAP lesions in 25 (40%). A Hill-Sachs lesion of less than 25% was noted in 24 patients. A glenoid defect of less than 20% was found in 7 patients. The mean duration of surgery was  $49.5 \pm 12$  minutes (range, 34–75 minutes).

Redislocation was seen in 5 patients (8.1%) in the postoperative period. In 2 patients, the cause of redislocation was major trauma. These patients underwent reoperation, and it was determined that the anchors were intact and that a separate labroligamentous lesion had formed. The lesion was repaired with same procedure. The cause of redislocation in the remaining 3 patients was simple trauma; they underwent reoperation during which the presence of a glenoid defect of less than 20% was observed, and arthroscopic capsuloligamentous reconstruction was performed. In the 5 patients who underwent revision surgery and an additional 3 patients, we found positive apprehension test results but no subluxation at final follow-up. These groups received no additional intervention during follow-up.

The mean preoperative Rowe and Constant scores were  $35 \pm 7.2$  and  $65 \pm 6.3$ , respectively. The final postoperative examination values were  $93.6 \pm 5.3$  and  $92 \pm 4.3$ , respectively. Subgroup scores are expressed in Table II. Clinically, significant improvement was observed in the Rowe and Constant scores in the postoperative period ( $P < .001$ ). Of the patients, 57 (91.9%) had good to excellent clinical scores. It was determined that postoperative redislocation was significantly correlated with contact sports ( $P = .04$ ) and younger age ( $P = .01$ ). The redislocation rate did not show any relation with sex, time to surgery, preoperative number of dislocations, grade of anterior

**Table I** Patients' demographic characteristics

	Non-recurrence group	Recurrence group	<i>P</i> value (Wilcoxon signed rank test)
Male/female patients, n	29/28	3/2	.234
Age at first dislocation, mean (SD), yr	27.2 (6.9)	20.1 (3.7)	.012*
Time to surgery, mean (SD), mo	12.4 (7.4)	5.2 (4.3)	.145
Preoperative dislocations, mean (range)	6.4 (2-12)	4.3 (1-11)	.431
Level of sports, n			
Contact	2	4	.041*
Recreational	28	1	.326
None	27	0	.464
Anterior translation			
Grade 1/2/3, n	25/17/15	1/3/1	.317
No. of anchors, mean (range)	2.8 (2-4)	3 (2-4)	.121
Hill-Sachs lesion, n			
<25%	22	2	.249
None	35	3	.421
Glenoid defect, n			
<20%	6	3	.112
None	53	2	.342
Follow-up, mean (SD), mo	29.1 (24-48)	26.6 (24-32)	.215

SD, standard deviation.

\* Statistically significant ( $P < .05$ ).

translation, number of anchors, Hill-Sachs lesions of less than 25%, and glenoid defects of less than 20% ( $P > .05$ ). The mean outcomes were better in patients who had Bankart lesions alone compared with patients who had other labral lesions (Table II).

## Discussion

After an average follow-up duration of 28.8 months, an 8.1% redislocation rate was found after arthroscopic glenoid labral repair using all-suture anchors. The postoperative Rowe and Constant scores were  $93.6 \pm 5.3$  and  $92 \pm 4.3$ , respectively. These results were found to comply

with those in the literature (Table III). In our study, the risk of recurrent instability increased significantly with younger age and contact sports, confirming the results of earlier research.

Several risk factors were identified in previous studies: large bone defects, hyperlaxity, male sex, and malpositioned anchors.<sup>14</sup> In our study group, we found no association between bone defects or hyperlaxity and recurrent instability because our study group included patients with glenoid defects of less than 20%, Hill-Sachs lesions of less than 25% that did not engage, and no generalized ligamentous laxity. Patient with larger defects and multidirectional instability underwent other surgical procedures in the study period. The postoperative functional results were not

**Table II** Comparison of Rowe and Constant scores in patients who underwent arthroscopic glenoid labral repair

	Bankart lesion (n = 27)	ALPSA (n = 3)	GLAD (n = 4)	Perthes lesion (n = 3)	Bankart lesion plus SLAP (n = 25)
Rowe score					
Preoperative	$38.2 \pm 3.2$	$30.2 \pm 5.2$	$31.4 \pm 4.6$	$33.5 \pm 3.4$	$33.1 \pm 5.5$
Postoperative	$96.7 \pm 3.1$	$90.7 \pm 4.3$	$91.4 \pm 2.3$	$92.7 \pm 4.2$	$91.5 \pm 2.4$
<i>P</i> value (Mann-Whitney <i>U</i> test)	<.001*	.003*	.001*	.004*	<.001*
Constant score					
Preoperative	$67.3 \pm 3.4$	$61.4 \pm 5.7$	$62.8 \pm 4.6$	$63.6 \pm 5.1$	$63.2 \pm 6.2$
Postoperative	$94.7 \pm 3.6$	$90.6 \pm 4.9$	$92.5 \pm 4.4$	$91.6 \pm 3.6$	$91.8 \pm 4.1$
<i>P</i> value (Mann-Whitney <i>U</i> test)	<.001*	.002*	.002*	.003*	<.001*

ALPSA, anterior labral periosteal sleeve avulsion; GLAD, glenolabral articular disruption; SLAP, superior labral tear from anterior to posterior.

\* Statistically significant ( $P < .05$ ).

**Table III** Recent clinical studies on arthroscopic Bankart repair and outcomes

Authors, year	N	Mean age, yr	Mean follow-up, yr	Outcomes	Recurrence rate, %
Vermeulen et al, <sup>27</sup> 2018	147	30 ± 11.1	6.3	WOSI score: 39 SST score: 11	22
Flinkkilä et al, <sup>11</sup> 2018	167	26 (15-58)	10	OIS: 20 WOSI score: 80	30
Nakagawa et al, <sup>19</sup> 2017	120	23 (14-69)	2	—	15
Aboalata et al, <sup>1</sup> 2017	143	28.1 ± 8.3	13	Rowe score: 90 Constant score: 94	18
Blonna et al, <sup>4</sup> 2016	30	31 (20-53)	5.3	OIS: 41 SPORTS score: 8	10
Milchhteim et al, <sup>16</sup> 2016	94	21 (15-43)	5	ASES score: 91.5 Rowe score: 84.3	6.4
Ng and Kumar, <sup>22</sup> 2014	45	21 (17-29)	2	VAS score: 0.7 Constant score: 92	0
Privitera et al, <sup>25</sup> 2012	20	43 (28-73)	13.5	WOSI score: 80 DASH score: 7.3	25
Zhu et al, <sup>32</sup> 2011	49	28 (16-54)	2	Constant score: 97.8 Rowe score: 89.8	8
Castagna et al, <sup>5</sup> 2010	31	26 (17-46)	10.9	Rowe score: 80.1 UCLA shoulder score: 32.1	19.4
Cho et al, <sup>6</sup> 2010	62	24.2 (16-38)	1.5	ASES score: 91.8 Rowe score: 94.1	0

WOSI, Western Ontario Shoulder Instability Index; SST, Simple Shoulder Test; OIS, Oxford Instability Score; SPORTS, Subjective Patient Outcome for Return to Sports; ASES, American Shoulder and Elbow Surgeons; VAS, visual analog scale; DASH, Disabilities of the Arm, Shoulder and Hand; UCLA, University of California at Los Angeles.

significantly correlated with the findings concerning the number of dislocations, time until surgery, grade of pre-operative anterior translation, sulcus findings, number of anchors, or sex. Similarly to the previous studies, the functional outcomes were better for the patients with isolated Bankart lesions.

This study primarily focuses on the clinical efficacy of the all-suture anchor, which is one of the many available anchor types. The development processes of suture anchors were evaluated, and the associated literature were presented. The evaluation of the anchor development processes indicates that the innovations can bring about several problems. For example, loosening of the metal anchor leads to complications associated with glenohumeral cartilage damage.<sup>8</sup> In addition, it is difficult to postoperatively evaluate the labral repair using MRI. These issues led to the development of bioabsorbable anchors. This new material also had its shortcomings, including loss of fixation due to early degradation, osteolysis due to increased inflammation, reactive synovitis, and chondral damage.<sup>23</sup> Subsequently, the polyetheretherketone (PEEK) and polyester-based biostable anchors and tricalcium phosphate-based biocomposite anchors were developed. At this point, it seems difficult to answer the following question: Is a perfect implant possible? The indicators of the past are the signs of the future, and science has not yet had its last word on this subject.

Suture anchors are devised based on design and material. Material-related problems lead to the use of different materials, and new designs are developed to facilitate the surgical process. In general, there are screws vs. impaction anchors and tacks vs. suture anchors. The anchors can be classified according to the material used (metal, bioabsorbable, biostable, and biocomposite) and as knotted and knotless anchors according to the properties of the suture.<sup>7</sup> Many studies have compared the clinical applications of the various available methods and instruments in the literature.

Peters et al<sup>24</sup> compared 4 different types of anchors in 155 cases of arthroscopic stabilization: 2 bioabsorbable (Suretac [Smith & Nephew], made of polyglycolic acid [PGA], and Bioknotless [DePuy Mitek, Raynham, MA, USA], made of polylactic acid enantiomers [PLLA]) and 2 permanent (OPUS Labrafix [Arthrocare, Sunnyvale, CA, USA], made of stainless steel, and PushLock [Arthrex, Naples, FL, USA], made of PEEK). They found no significant difference in the average American Shoulder and Elbow Surgeons scores between the different types of anchors. The Rowe score results were similar in the first 6 months; however, after the 1-year follow-up, the scores were significantly lower for the Suretac and Bioknotless groups compared with the Labrafix and PushLock groups. Peters et al indicated that for recurrent traumatic anterior instability, the use of bioabsorbable anchors led to a 5-year

recurrence rate of 40% to 60% whereas the use of permanent anchors yielded excellent outcomes, with a 5-year recurrence rate of 5% to 6%.

Milano et al<sup>15</sup> evaluated 78 arthroscopic stabilization cases to compare metal anchors (FASTak; Arthrex) and bioabsorbable anchors (Bio-FASTak with Poly-L/DL-lactic acid; Arthrex). They did not find significant differences in the Disabilities of the Arm, Shoulder and Hand score; Rowe score; and Constant score. At the 2-year follow-up, a total recurrence rate of 4.3% was reported: 1 patient from the metal anchor group and 2 patients from the bioabsorbable anchor group. As a result, Milano et al stated that the use of metal and bioabsorbable anchors did not make a clinically significant difference at short-term follow-up.

Kocaoglu et al<sup>13</sup> evaluated 38 arthroscopic stabilization cases to compare the use of knotted (metal; Arthrex, USA) and knotless (PushLock with PEEK, Arthrex, USA) anchors. They found the average Rowe scores to be 92 and 91.2, respectively, and reported a recurrence rate of 5.2% (1 patient in each group). They concluded that the knotless anchor was less complicated than the knotted anchor and provided a safe and low-profile repair.

Voos et al<sup>28</sup> evaluated 83 recurrent traumatic anterior instability patients who were operated on with bioabsorbable and metal anchors. The mean American Shoulder and Elbow Surgeons score was 94.6. Thirteen patients had a redislocation or recurrence with subluxation. Voos et al concluded that, independently of the number or type of anchors, the risk factors for recurrence were age of 25 years or younger, the presence of ligamentous laxity, and the presence of extensive Hill-Sachs lesions.

Similarly, in the presence of recurrent traumatic anterior instability, arthroscopic repair of Bankart lesions showed similar and good outcomes for absorbable tacks<sup>9</sup> and fast-absorbing biocomposite anchors.<sup>17</sup>

The polyester-based all-suture anchor (Q-Fix or Juggernaut) that we used in this study has been presented in biomechanical studies.<sup>3,10</sup> Its use was also demonstrated in a clinical trial in which triple labral lesions were repaired with the Juggernaut.<sup>2</sup> To our knowledge, our study is the second clinical study using the all-suture anchor.

German architect Mies van der Rohe defined minimalism with the phrase “less is more.” We used the all-suture anchor with this notion in mind, thinking that “the best implant is the less implant.” The advantages of the all-suture anchor include its smaller carving diameter and its allowance for more bone reserve and anchorage, its flexible structure and elimination of rigidity-related complications, and its adequate fixation despite the relatively low tensile strength. In this study, the recurrence rate was 8.1% after a mean 28.8-month follow-up.

## Limitations

This study has several limitations. The primary limitation is the absence of a control group that includes anchors with different materials and designs. The results were objectively compared with the literature; however, it should be noted that surgical abilities have a direct effect on outcomes. Another limitation is that this study did not present the drill-hole configuration and osseous reaction images as these findings can only be obtained with long-term follow-up. The questions “What does the body do to the anchor?” and “What does the anchor do to the body?” need to be answered by future studies.

## Conclusion

The use of all-suture anchors for arthroscopic glenoid labral lesion repair for the treatment of recurrent traumatic anterior shoulder instability yields satisfactory clinical results and is a safe and effective option.

## Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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