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Outcomes of primary arthroscopic shoulder stabilization in active patients over 40—results at a mean follow-up of 7 years

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Background: The purpose of this study is to report clinical outcomes, return to activity, redislocation rate, and rate of conversion to arthroplasty for active patients over age 40 undergoing primary arthroscopic shoulder stabilization.

Methods: Patients over 40 years of age who underwent arthroscopic capsulolabral repair for shoulder instability between December 2005 and January 2018 with a minimum of 2-year postoperative follow-up were enrolled in this retrospective, monocentric study. Clinical outcome scores including the 12-Item Short-Form Survey, American Shoulder and Elbow Surgeons (ASES), Quick Disabilities of the Arm, Shoulder, and Hand, Single-Assessment Numeric Evaluation, and visual analog scale pain were collected. Additionally, it was determined which patients reached the minimal clinically important difference and the patient-acceptable symptom state for the ASES score. Bivariate analysis was utilized to determine if there was any association between baseline demographic and clinical factors with the outcome scores.

Results: Of a total of 814 patients assessed for eligibility, an aggregate of 40 patients were included and 33 patients (8 females) were available for follow-up. The average age was 49.4 ± 7.6 years. At an average follow-up of 7.0 ± 3.6 years, all the outcome scores significantly improved compared to baseline. These included ASES (69.9 ± 19 to 95.8 ± 7.6, $P < .001$); the Quick Disabilities of the Arm, Shoulder, and Hand score (29.7 ± 17.7 to 3.9 ± 5.4, $P < .002$); Single Assessment Numeric Evaluation score (53.5 ± 29.3 to 91.6 ± 14.3, $P < .003$); the 12-Item Short-Form Survey (45.6 ± 8.8 to 55.2 ± 5.7, $P < .001$); and the visual analog scale (2.1 ± 2.1 to 0.3 ± 1, $P < .002$). The minimal clinically important difference was reached by 72.7% of the patients and 81.8% reached the patient-acceptable symptom state threshold for the ASES score. Postoperative shoulder stability improved substantially and significantly. Median postoperative satisfaction was 10/10 (range 1-10). Ninety-five-point-six percent of the patients returned to sport, with 91.0% of the patients able to return to preinjury level. One patient (3%) underwent revision surgery for osteoarthritis, in the form of comprehensive arthroscopic management procedure. The presence of cartilage defects cartilage defects Outerbridge grade >2 ($P = .020$) and posterior labral lesions ($P = .03$) at index surgery were significantly associated with inferior outcomes in the ASES score.

Conclusion: Active patients aged 40 years and older undergoing arthroscopic shoulder stabilization experienced favorable functional outcomes at a mean follow-up of 7 years, with low rates of revision surgery or of progression to clinically relevant osteoarthritis. However, the presence of high-grade cartilage lesions and the presence of a posterior labral tear were associated with inferior clinical outcomes.

Glenohumeral dislocations account for approximately 50% of all major dislocations with an incidence of 2%-8% of the population.[1,5,9,46] Given that first-time dislocations typically occur traumatically, glenohumeral instability predominantly affects younger and more active populations.[31,46] However, up to 18% of the patients sustaining a shoulder dislocation are aged 40-60 years.[17,36,49] As the population continues to age and remain active, it can be

The Vail Health Hospital Institutional Review Board approved this study. Protocol 2023-168.

This research was performed at the Steadman Philippon Research Institute.

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expected that the number of middle-aged to elderly patients that suffer a shoulder dislocation and subsequent recurrent shoulder instability will increase, as more patients continue to participate in high-risk activities into older age.[7,23,36]

Compared to the young and active patient population, older patients have been reported to develop significantly lower rates of subsequent shoulder instability following a first-time dislocation, with the rate of subsequent instability following a first-time dislocation ranging 0%-17% in patients 40 years and older compared to 74%-100% in patients under the age of 40.[7,19,22,23,33,34,36,37,39,48]

Given the lower risk of the development of recurrent shoulder instability with increasing age,[33] historically, nonoperative treatment of shoulder instability has widely been regarded as a valid treatment option after first time dislocation in older patients.[33] However, recurrent instability may persist in up to 17% of the active patients aged 40 years and older following first-time dislocation.[33] While surgical stabilization may be a treatment option for these patients,[36,45] concern exists that surgical stabilization in older patients may lead to stiffness and an early onset of instability arthropathy due to a potential overconstraint of the joint.[2,11]

In this regard, there remains a paucity of data on the outcomes following isolated arthroscopic shoulder stabilization in patients 40 years and older[10,35] with existing studies reporting relatively heterogenous postoperative clinical outcomes.[7,10] This scarcity of data is largely attributable to the incidence of concomitant rotator cuff tear (RCT) in 35%-86% of shoulder dislocations in patients over 40.[17,18,29,34,44,45] Since this injury is composed of inherently different combinations of pathologies and follows a different rehabilitation protocol, existing outcomes data for labral repair with concurrent rotator cuff repair may not be applicable to patients with isolated labral pathology. Additionally, evidence concerning the return to physical activity in active patients aged 40 years and older is particularly limited,[25] even though these data are paramount to individual postoperative satisfaction of the active patient.[42]

Thus, the purpose of this study was to report clinical outcomes, return to activity, redislocation rate, and rate of conversion to arthroplasty for patients undergoing isolated arthroscopic labral repair and stabilization. It was hypothesized there would be favorable outcomes in patients 40 years and older undergoing labral repair for shoulder instability, with a low rate of recurrent instability and clinically relevant arthropathy.

Methods

This was an institutional review board (VHH 2023-168)–approved retrospective study of prospectively collected data. Patients within our institutional data bank were assessed for eligibility if they underwent labral repair of the shoulder by a single surgeon (PJM) and were at least 2 years out from surgery. Patients were included if they were aged 40 years or older at the time of surgery, suffered from symptomatic shoulder instability that had failed nonoperative management, and if they underwent primary arthroscopic capsulolabral repair for shoulder instability between December 2005 and January 2018. Not all patients were 40 years old at the time of the first episode of instability. Patients were excluded if they underwent open stabilization surgery, had undergone a previous stabilization procedure on the index shoulder, had a stabilization procedure other than an isolated capsulolabral repair, had high-grade glenohumeral arthritis, had a concomitant fracture of the glenoid, humerus, or clavicle, if they underwent reconstruction of the acromioclavicular or sternoclavicular joint, if they underwent a distal clavicle excision, or if they underwent concomitant rotator cuff repair or other concomitant reconstructive procedures unrelated to labrum or long head of the biceps tendon. Patients were considered treatment failures if they underwent the following: 1) a revision shoulder stabilization or 2) surgery for glenohumeral osteoarthritis during the follow-up interval. The percentage of patients with treatment failure was reported and these patients were included in the risk factor analysis.

Indication

Patients with a history of dislocations or subluxations, who had clinical apprehension signs, and who had failed nonoperative management were indicated for surgical stabilization. Arthroscopic labral repair and stabilization was recommended in the absence of clinically relevant bone defects of the glenoid and/or humerus. Anterior instability was tested clinically with the apprehension sign and the relocation test, and posterior instability was tested with the jerk test.[6,27,41] Advanced imaging such as magnetic resonance imaging or computed tomography was evaluated for the presence of glenoid or humeral bone loss in all cases.[21] Patients with clinically relevant glenoid bone loss <17.3[38] were considered for a bone block procedure such as a Latarjet coracoid transfer and were excluded from this study. Patients with the presence of an *off track* Hill-Sachs lesion according to the glenoid track concept, which was addressed with either bone block augmentation at the glenoid, humeral defect filling, or remplissage procedure, were also excluded from this study.[3] Specific labral tear configurations at index surgery, such as glenolabral articular disruption lesions, superior labrum anterior to posterior (SLAP) tears, anterior labroligamentous periosteal sleeve avulsion *lesions,* or Perthes lesions were noted.

Surgical technique

Arthroscopic capsulolabral repair was performed as previously described.[8,20] The patient was positioned in the beach chair position and an examination under anesthesia was performed to confirm the diagnosis. For anterior labral repair and capsulorraphy, a standard posterior viewing portal and 2 anterior working portals were established. Careful mobilization of the capsulolabral complex was carried out to ensure proper alignment of the labrum with the glenoid and create a capsulolabral bumper. Next, a bleeding bed was created on the glenoid rim, although the cortical bone was preserved. Knotless anchors (before October 2017: Bio-knotless SutureTak; Arthrex, Inc., Naples, FL, USA; after October 2017: 1.8-m knotless FiberTak; Arthrex, Inc., Naples, FL, USA[8,20]) were placed at 5:30 o'clock (right shoulder) position in most cases. The repair suture was passed around the capsulolabral complex to repair the labrum and shift the capsule from lateral to medial and inferior to superior. The repair suture was then passed through the anchor, and the soft tissue was compressed against the labrum and capsule to establish the desired tension. Subsequent anchors were placed superiorly to repair the detached labrum. On average, a total of 4 anchors were used for the Bankart repairs, starting from inferior to superior at the 4:00, 3:30, and 2:00 o'clock positions. When the tear extended posteriorly, posterior anchors were also placed. For posterior repair, the anchors were placed at the 6:00, 7:00, 8:00, and 9:00 o'clock positions (right shoulder) as needed. If there was an extension of the tear superiorly into a SLAP tear, additional anchors were placed as necessary to stabilize the SLAP complex and if the biceps appeared degenerated or there was an associated bicpes pulley lesion, the long head of the biceps was released to prevent traction on the repair and a subpectoral biceps tenodesis was performed.

Postoperative rehabilitation

Patients were placed in a sling for 4 weeks (anterior repair) or 6 weeks (posterior repair). Passive range of motion (ROM)

exercises were allowed immediately, with a restriction of external rotation to 30° for the first 3 weeks. At 3 weeks, active assisted ROM exercises as well as submaximal isometric exercises were introduced, while full passive and active ROM exercises were initiated at 4 weeks. If a concomitant biceps tenodesis was performed, resisted elbow flexion exercises were avoided for a period of 6 weeks. Muscular strengthening exercises involving isometric contractions commenced at around 5 to 6 weeks postoperatively. Typically, patients were allowed to return to full unrestricted activities approximately 4 months after the operation.

Clinical evaluation

Patient-reported outcome measures (PROs) were collected preoperatively and at a minimum follow-up of 2 years postoperatively. These PROs included the 12-item Short-form Physical Component Summary (SF-12 PCS), American Shoulder and Elbow Surgeons score (ASES) (Scale 0-100, 100 = best), Single-Assessment Numeric Evaluation (SANE) (Scale 0-100, 100 = best), Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) (Scale 100-0, 0 = best), and visual analog scale (VAS) (Scale 0-10, 0 = best) pain scores. The percentage of patients who reached the minimal clinically important difference (MCID) was calculated utilizing the MCID threshold for the ASES score previously established for arthroscopic labral repair (8.5 points)[32] Furthermore, the percentage of patients who reached the patient-acceptable symptom state (PASS) was calculated utilizing a previously established PASS threshold for the ASES score (86 points).[26] Patients that had proceeded to revision surgery were categorized as not having reached MCID or PASS, irrespective of the scores before revision.

In terms of instability-specific questions, patients were asked about the presence of any type of shoulder instability. If affirmative, further questions were included to delineate the nature of instability. First, patients were asked to indicate the incidence and number of shoulder dislocations and whether those episodes required external assistance for reduction. Further, patients were asked to categorize the frequency of recurrent shoulder instability sensations as “never,” “rarely,” “occasionally,” or “frequently”. Patients were then asked to rate their postoperative shoulder stability as either “much better,” “better,” “same,” “worse,” or “much worse” compared to preoperatively.

Given that progression to glenohumeral osteoarthritis, which typically manifests as shoulder pain, was hypothesized as a potential mode of failure in this older cohort of patients following labral repair, the impact of pain was assessed in more detail. For this purpose, patients were asked to rate the impact of pain on their activities of daily life, recreational activity and sleep on a scale of (0) none, (1) mild, (2) moderate, or (3) severe.

Lastly, at the final follow-up, patients were asked to rate their satisfaction on a scale from 1 to 10 and were asked to specify whether they would have surgery again.

Return to activity

To evaluate a patient's ability to return to their sport of choice (RTS), they were asked to rate their ability to participate in sports with respect to their shoulder using the following response options: (1) at or above preinjury level, (2) slightly below preinjury level, (3) moderately below preinjury level, (4) significantly below preinjury level, (5) unable to participate in their usual sport, or (6) unable to participate in any sports. Return to activity was defined as selecting options (1) through (4), while a successful return to activity approximately at preinjury level was considered selecting options (1) or (2). To assess qualitative RTS parameters, patients were asked to rate their competition or participation intensity in their usual sport compared to their preinjury level, both preoperatively and postoperatively, using the following options: (1) Same or better than preinjury level, (2) 75%-99% of preinjury level, (3) 50%-74% of preinjury level, (4) 25%-49% of preinjury level, (5) less than 25% of preinjury level, or (6) unable to participate in any sports.

To evaluate the impact of shoulder instability on sports participation, participants were asked to rate their ability to compete in sports ("No problems during competition," "I have instability, but can continue to compete," "I rarely have to stop competing," "I occasionally have to stop competing," "I frequently have to stop competing," or "I cannot compete due to instability"). In addition, participants were asked whether putting their arm in a certain position interfered with their ability to compete in sports ("No," "Yes, with my arm above my head," or "Yes, with my arm in front of my body").

Predictive factor analysis

To delineate the potential role of patient factors at baseline on the postoperative outcomes, a bivariate analysis was performed to analyze the influence of the grade of cartilage defects according to Outerbridge (≤ 2 vs. > 2), the direction of instability (anterior, posterior), participation in overhead sports, and the number of preoperative dislocations (<2 vs. ≥ 2 in anterior instability cases)[15] on postoperative PROs and the propensity to reach the MCID of the ASES score. Furthermore, a correlation analysis between patient age and postoperative PROs was conducted.

Statistical analysis

A priori power analysis, performed with G*Power (Heinrich Heine Universität, Düsseldorf, Germany), determined that a total sample size of 26 subjects was necessary to detect a clinically relevant difference, such as the MCID of 8.5 points in the ASES score,[32] at a calculated effect size of 1.12 with a statistical power of 0.8.[14]

Statistical analysis was performed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were reported as mean ± standard deviation. Categorical variables were reported as count and percentages. The distribution of continuous variables in the study collective was categorized via the Shapiro–Wilk-Test. According to their respective distribution, continuous variables were compared employing either a parametric unpaired t-test or the nonparametric Mann–Whitney *U* test. Categorical variables were compared utilizing the binary Fisher's exact test or the Chi-square test, as statistically appropriate. In non–normally distributed data, the nonparametric Wilcoxon test for 2 related samples was used to compare preoperative and postoperative values of each outcome parameter. The level of significance was set at $P < .05$.

Results

A total of 814 patients who underwent arthroscopic labral repair during the study period were assessed for eligibility, of whom 160 patients were aged 40 years and older at the time of surgery. Of those patients, n = 120 patients were excluded for different reasons illustrated in Figure 1. The remaining 40 patients (age: 49.4 ± 7.6 years, range 40.5-74.7; 8 females) were included in the final study cohort. Despite our best attempts to attain follow-up, 6/40 patients (15%) were lost to follow-up. The remaining 33 patients included 1 failure, who developed progressive osteoarthritis and went on to

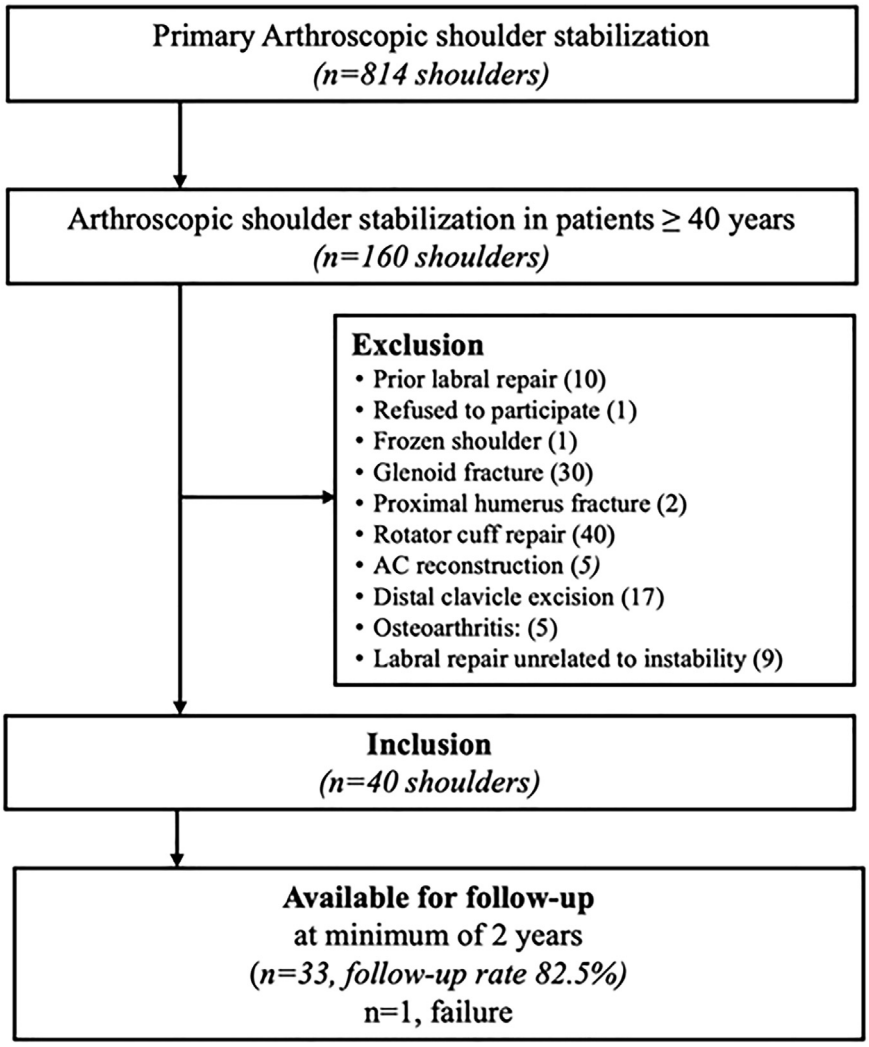

Figure 1 Flow chart visualizing the patient population for this study after accounting for inclusion criteria, exclusion criteria, failures and those lost to follow-up.

revision surgery in the form of a comprehensive arthroscopic management surgery.[4] Thirty-two patients were included for further analysis of clinical outcomes. A flowchart detailing the inclusion and exclusion process is provided in Figure 1. A detailed description of demographics and surgical details is provided in Table I.

Clinical outcome

The preoperative scores were compared to scoring at final follow-up at an average of 7.0 ± 3.6 years postoperatively. Within the study population, statistically significant improvements in postoperative SF-12 PCS (<.001), ASES (<.001), QuickDASH score (<.002), SANE (<.003), and VAS pain (<.002) were observed at follow-up in comparison to baseline scores (Table II). Seventy-two-point seven percent achieved the MCID and 81.8% of the patients had sustained improvement exceeding the PASS threshold at the final follow-up.

At the final follow-up, 1 patient (3%), aged 51 years at index surgery, had proceeded to a comprehensive arthroscopic management procedure[4] for glenohumeral osteoarthritis at 8.4 years after index surgery.

A total of 3 (9.1%) patients reported postoperative dislocations. Furthermore, 1 patient reported occasional shoulder subluxations (3%) and 1 reported frequent (3%) subluxations. While 22 patients (66.7%) registered no shoulder instability at all, 9 (27.3%) patients rated their instability as "much better," 1 (3%) patient rated their instability as "worse," and 1 (3%) patient rated their instability as "much worse" compared to preoperatively.

Regarding postoperative pain, patient-reported impact of pain on activities of daily livings ($P < .001$), recreational activities ($P < .001$), and sleep ($P < .001$) significantly improved compared to preoperatively; specific details can be found in Table III.

At the final follow-up, the mean satisfaction was 10/10 (range 1-10). Eighty-four-point-four percent of the patients reported they would have the surgery again.

Return to activity

Preoperatively, 33 (100%) patients were involved in athletic activity. Of those patients, 15 (45.5%) were involved in overhead activity. Postoperatively, 95.6% of the patients who participated in the RTS analysis were able to return to activity, while 91% of the patients successfully returned to a level similar to their preinjury level. Patients reported that they rarely (n = 1) or occasionally (n = 4) had to stop participation due to their shoulder, and 1 patient could not compete at all due to instability. A total of 3 patients

Table I
Demographic and surgical variables.

Variable	Value
Age at surgery	49.4 ± 7.6
Injury at dominant arm	19 (57.6%)
Sex	
Female	8 (24.2%)
Male	25 (75.8%)
Workers compensation	3 (9.1%)
Reason for seeking medical care (more than only response possible)	
Pain	21 (63.6%)
Weakness	15 (45.5%)
Shoulder coming out	20 (60.6%)
Number of preoperative dislocations	3 (range: 0-35)
Specific labral tear configuration	
GLAD	3 (9.1%)
ALPSA	1 (3.0%)
SLAP lesion	20 (60.6%)
Preoperative outerbridge grade	
Cartilage defect	
Humerus	10 (30.3%)
Outerbridge grade 1 & 2	2 (6.1%)
Outerbridge grade 3 & 4	8 (24.2%)
Glenoid	19 (57.6%)
Outerbridge grade 1 & 2	16 (48.4)
Outerbridge grade 3 & 4	3 (9.1%)
Hill Sachs lesion	9 (27.2%)
Labral repair	
Anterior	24 (72.7%)
Posterior	9 (27.2%)
Number of anchors utilized	4 ± 1 (range: 2-8)
Concomitant procedures	
Microfracture	3 (9.1%)
Remplissage	2 (6.1%)
SLAP repair	9 (27.2%)
Biceps tenodesis	13 (39.4%)

GLAD, glenolabral articular disruption; *ALPSA*, anterior labroligamentous periosteal sleeve avulsion lesion; *SLAP*, superior labral anterior to posterior.
Continuous variables are presented as mean ± standard deviation (range); Categorical variables are presented as count and percentage.

Table II
Continuous variables are presented as mean ± standard deviation (range); categorical variables are presented as count and percentage.

PRO	Preoperatively	Postoperatively	*P* value
SF-12 PCS	45.6 ± 8.8 (30.3-62.2)	55.2 ± 5.7 (32.8-59.5)	<.001
ASES	69.9 ± 19 (14.9-93.3)	95.8 ± 7.6 (64.9-99.9)	<.001
QuickDASH	29.7 ± 17.7 (6.8-63.6)	3.9 ± 5.4 (0-15.9)	<.002
SANE	53.5 ± 29.3 (0-99)	91.6 ± 14.3 (49-100)	<.003
VAS pain	2.1 ± 2.1 (2-10)	0.3 ± 1.0 (6-10)	.002

PRO, patient-reported outcomes; *SF-12 PCS*, 12-item Short-form Physical Component Summary; *ASES*, American Shoulder and Elbow Surgeons score; *SANE*, Single Assessment Numeric Evaluation; *QuickDASH*, Quick Disabilities of the Arm, Shoulder, and Hand; *VAS*, visual analog scale.

reported that an arm position above the head interfered with sport participation, while one patient listed arm position in front of the body as interfering with sports competition. More details on the preoperative to postoperative ability to participate in athletic activity is listed in Table IV and Figure 2.

Predictive factor analysis

A preoperative cartilage lesion of either the humerus or glenoid of Outerbridge grade 3 or greater was significantly associated with an inferior postoperative ASES score ($P = .020$), and a significantly lower percentage of these patients were able to reach the MCID (86.4% vs. 42.9%). The presence of a posterior labral tear was associated with significantly inferior ASES ($P = .03$), QuickDASH (0.026), SANE ($P = .030$), and VAS pain ($P = .018$) scores. Age did not significantly correlate with either SF-12 PCS ($P = .953$), ASES ($P = .19$), QuickDASH ($P = .369$), SANE ($P = .573$), or VAS pain ($P = .251$) scores. Participation in overhead sports and the number of preoperative dislocations were not significantly associated with any postoperative PROs (Supplementary Table S1).

Table III
Pain-specific outcome variables.

Questions	Response options	Preoperatively	Postoperatively	*P* value
Impact of pain on activities of daily life	None	4 (13.3%)	26 (78.8%)	<.001
	Mild	12 (40%)	2 (6.1%)	
	Moderate	11 (36.7%)	4 (12.1%)	
	Severe	3 (10%)	1 (3%)	
Impact of pain on recreational activity	None	1 (3.2%)	22 (66.7%)	<.001
	Mild	2 (6.5%)	5 (15.2%)	
	Moderate	15 (48.4%)	4 (12.1%)	
	Severe	13 (41.9%)	2 (6.1%)	
Impact of pain on sleep	None	3 (9.7%)	24 (72.7%)	<.001
	Mild	9 (29%)	5 (15.2%)	
	Moderate	15 (48.4%)	2 (6.1%)	
	Severe	4 (12.9%)	2 (6.1%)	

Continuous variables are presented as mean ± standard deviation (range); Categorical variables are presented as count and percentage.

Discussion

This study provides evidence for 2 major findings: First, patients aged 40 years and older undergoing arthroscopic shoulder stabilization for shoulder instability experienced favorable functional outcomes at a mean follow-up of 7 years, with a low rate of revision or progression to clinically relevant osteoarthritis. Second, the presence of high-grade cartilage lesions and posterior labral tears at the time of index surgery were associated with inferior clinical outcomes. These findings may be helpful in the decision making on the optimal management of shoulder instability in the older athlete and assist in preoperatively managing patient expectations for clinical and sports-related outcomes following arthroscopic labral repair for shoulder instability in patients aged 40 years and older.

To date, there is no consensus on how to optimally manage glenohumeral instability in patients aged 40 years or older.[2,10,11,33,34,39] The results of this study underline the positive effect of arthroscopic labral repair in middle-aged and older patients that failed nonoperative treatment. In the present study, all patient-reported outcome scores significantly improved from preoperatively to postoperatively, with 72.7% of patients achieving the MCID and 81.8% surpassing the PASS threshold. Additionally, only 1 patient (3.0% failure rate) progressed to comprehensive arthroscopic management of glenohumeral osteoarthritis and no patients progressed to total shoulder arthroplasty at the time of the final follow-up. This study is one of the first in the literature to report on outcomes after isolated labral repair, which is largely attributable to the fact that in the middle-aged and older patient, a dislocation event oftentimes results in a RCT.[29] However, the outcomes reported in the present study are comparable to previous investigations of patients aged 40 years and older undergoing shoulder stabilization surgery including patients that underwent concomitant rotator cuff repair.[12,13,24,35] Ro et al reported on 50 patients over 40 years of age, of which 18% had RCTs, and found a

Table IV
Activity-specific outcomes.

Questions	Response options	Preoperatively	Postoperatively	*P* value
Ability to participate in sports with respect to the shoulder	At or above preinjury level	2 (8.3%)	14 (60.9%)	<.001
	Slightly below preinjury level	2 (8.3%)	7 (30.4%)	
	Moderately below preinjury level	4 (16.7%)	1 (4.3%)	
	Significantly below preinjury level	5 (20.8%)	0 (0%)	
	Unable to participate in their usual sport	5 (20.8%)	0 (0%)	
	Unable to participate in any sports	6 (25%)	1 (4.3%)	
Intensity of competing or participating in usual sport preinjury level	Same or better than preinjury level			.005
	75%-99% of preinjury level	2 (9.5%)	12 (52.2%)	
	50%-74% of preinjury level	2 (9.5%)	7 (30.4%)	
	25%-49% of preinjury level	9 (42.9%)	4 (17.4%)	
	Less than 25% of preinjury level	2 (9.5%)	0 (0%)	
	Unable to participate in any sports	6 (28.6%)	1 (4.3%)	
Participation in sports	Unable	4 (13.8%)	1 (3%)	<.001
	Very difficult	11 (37.9%)	2 (6.1%)	
	Somewhat difficult	11 (37.9%)	3 (9.1%)	
	Normal	3 (10.3%)	27 (81.8%)	
Participation in recreational activity	Unable	8 (28.6%)	1 (3%)	<.001
	Very difficult	9 (32.1%)	3 (9.1%)	
	Somewhat difficult	9 (32.1%)	3 (9.1%)	
	Normal	2 (7.1%)	26 (78.8%)	

Continuous variables are presented as mean ± standard deviation (range); Categorical variables are presented as count and percentage.

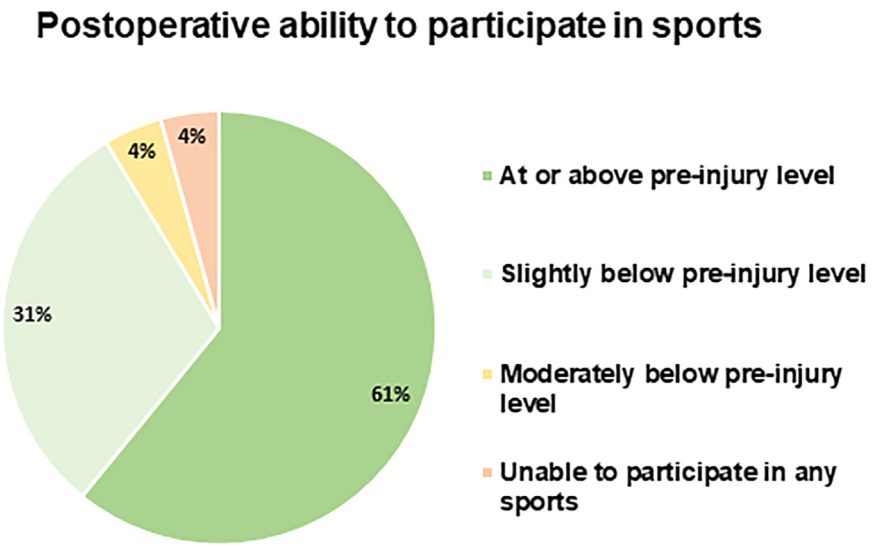

Figure 2 Graphical representation of the postoperative ability of patients to participate in sport.

redislocation rate of 14%, which is slightly elevated when compared to our recurrent instability rate of 9.1%.[36] In regards to the significant improvement in PROs found from preoperatively to postoperatively in the present study, both[24] Porcellini et al and Ernstbrunner et al found significant increases in Rowe and Constant scores in patients over the age of 40 after arthroscopic shoulder stabilization with or without rotator cuff involvement.[12,13,35] Regarding return to activity, the RTS rate of 95.6% reported in the present study is superior to the RTS rate of 77% previously reported by Voos et al for 30 patients with a mean age of 47.8 years old after labral repair with concurrent rotator cuff repair.[45]

For the middle-aged to elderly patient with shoulder instability, historically, nonoperative treatment has been considered as a viable treatment option.[47] The apprehension to perform surgical shoulder stabilization has largely been due to perceived risk of postoperative stiffness and accelerated onset of instability arthropathy following surgical stabilization that may outweigh the benefit for older patients, who have a lower risk of recurrent instability following nonoperative treatment compared to younger patients.[2,11,33,34,39] However, our study failed to support the notion that operative shoulder stabilization accelerates the development of glenohumeral osteoarthritis, with only 1 patient (3%) presenting with clinically relevant osteoarthritis at the time of the final follow-up. In patients over the age of 50, Smartt et al previously reported that the rate of progression to osteoarthritis was slightly increased in patients with anterior shoulder instability treated operatively vs. nonoperatively, but this difference was not statistically significant.[40] The rate of recurrent instability was also found to be significantly higher in patients treated nonoperatively.[40] Similarly, Wasserstein et al conducted a systematic review of nonoperative treatment of patients with shoulder instability, reporting recurrence rates that range from 26% to 57.1% in patients aged 40 years and older,[47] which is elevated compared to our recurrent instability rate of 9.1% after operative treatment.[47]

Further, the results in this patient cohort aged 40 years and older do not appear to differ significantly from the outcomes reported in younger patient populations.[22] Although a study by Maier et al comparing outcomes of shoulder stabilization in patients over and under the age of 40 found significantly inferior outcomes results in older patients, this study did not control for the increased incidence of concurrent RCTs and proximal humerus fractures in the group of patients over the age of 40, which may explain their findings.[24] In terms of redislocation rate compared to younger cohorts, Grumet et al found, with an average age at surgery ranging from 20.5 to 32 and a minimum 2 years to final follow-up, that average recurrence rates ranged from 0% to 45%, placing the recurrence rate of 9.1% observed in the present study at the low end of the included studies.[14] This systematic review also indicated ASES scores ranging from 87 to 94.7 and SANE scores ranging from 88 to 93.5,[16] in line with the average ASES score of 95.8 and SANE score of 91.6 observed in the present study. Thus, although clear consensus has not been reached regarding the optimal treatment of middle-aged to elderly patients with shoulder instability, it appears that surgical intervention provides reliable reduction of shoulder pain and reduces the risk of recurrent shoulder instability, similar to younger patient populations.

Notably, the subgroup analysis in the present study showed that in patients over 40 years of age, the age does not correlate with any of the PROs. Additionally, the predictive analysis performed demonstrates that Outerbridge stage greater than 3 results in significantly decreased ASES scores in patients. This is consistent with Nourissat et al reporting that glenoid cartilage lesion was the only factor that was associated with a decreased Constant score in bone block, Bankart, or capsular plication procedures.[30] Interestingly, the subgroup analysis also showed significantly worse patient-reported outcomes scored for patients with posterior instability compared to anterior instability. This may be due to posterior labral tears being an indicator of posterior wear and may coincidence with posterior cartilage wear as a sign of early osteoarthritis.[28,43]

The analysis of this study must however be interpreted within the context of the limitations. First, given that clinical outcome scores and return to activity were elected as primary and secondary endpoints, radiographic evaluation was not performed at the final follow-up to evaluate a radiographic progression of osteoarthritis to minimize patient exposure to radiation. However, a detailed analysis of pain as the clinical correlate for instability arthropathy was performed to mitigate the risk of under-reporting progression to clinically relevant osteoarthritis. Second, regarding the return to activity analysis, the results may be biased by factors such as natural drop off in sports participation with age and other confounding injuries or factors unrelated to the shoulder that could have affected the ability to be active in sports at a mean of 7 years postoperatively. Third, the external validity of these findings may be limited, as the results represent the outcomes of patients from a single, high-volume surgeon. Fourth, this study was designed as a case series and a comparison group of patients undergoing a nonoperative treatment or labral repair with concomitant procedures was not included. Fifth, a younger comparison group was not included in this study as younger patients are more likely to participate and return to more strenuous activities resulting in a potentially more intense stress placed on the glenohumeral joint, therefore rendering the comparison of limited meaningfulness. This decision was made because the primary goal of the investigation was to provide a comprehensive report on patients 40 years and older and add to the current paucity of literature in this patient population. Last, the study was powered on the MCID of the ASES score and while it was sufficiently powered for the analysis of the ASES score, we cannot exclude that it might be underpowered for the analysis of other endpoints.

Conclusion

Active patients aged 40 years and older undergoing arthroscopic shoulder stabilization experienced favorable functional outcomes at a mean follow-up of 7 years at a low rate of revision or progression to clinically relevant osteoarthritis. However, the presence of high-grade cartilage lesions as well as the presence of a posterior labral tear were associated with inferior clinical outcomes.

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Supplementary Data

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