Original Article

Patients Aged >50 Years With Anterior Shoulder Instability Have a Decreased Risk of Recurrent Dislocation After Operative Treatment Compared With Non-Operative Treatment

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Purpose: To compare the clinical outcomes of operative and nonoperative management, identify risk factors for recurrent instability, and identify risk factors for progression to surgery after failed nonoperative management for patients with first-time anterior shoulder dislocation after the age of 50 years. **Methods:** An established geographic medical record system was used to identify patients who experienced a first-time anterior shoulder dislocation after the age of 50 years. Patient medical records were reviewed to identify treatment decisions and outcomes of interest, including rates of frozen shoulder and nerve palsy, progression to osteoarthritis, recurrent instability, and progression to surgery. Outcomes were evaluated using Chi-square tests and survivorship curves were generated using Kaplan-Meier methods. A Cox model was developed to evaluate for potential risk factors of recurrent instability and progression to surgery after an initial trail of at least 3 months of nonoperative treatment. **Results:** 179 patients were included with a mean follow-up of 11 years. 14% ($n = 26$) underwent early surgery within 3 months and 86% ($n = 153$) were initially treated nonoperatively. Mean age (59 years), was similar for both groups, but those that underwent early surgery had an increased rate of full-thickness rotator cuff tears (82% vs 55%; $P = .01$), labral tears (24% vs 8.0%; $P = .01$), and humeral head fracture (23% vs 8.5%; $P = .03$). When comparing the early surgery group to the nonoperative group, there were similar rates of persistent moderate-severe pain (19% vs 17%; $P = .78$) and frozen shoulder (8 vs 9%, respectively; $P = .87$) at final follow-up. Although nerve palsy (19% vs 8%; $P = .08$) and progression to osteoarthritis (20% vs 14%; $P = .40$) were more common in surgical patients, they experienced lower rates of recurrent instability after surgical intervention (0% vs 15%; $P = .03$) compared to nonoperatively treated patients. Increasing number of instability events prior to presentation was the greatest risk factor for recurrent instability (HR 232; $P < .01$). Fourteen percent ($n = 21$) failed initial nonoperative treatment and proceeded to surgical intervention at an average of 4.6 years after the initial instability event, and the greatest risk factors for progression to surgery were recurrent instability (HR 3.41; $P < .01$). **Conclusions:** Although the majority of patients >50 years that experience ASI are treated nonoperatively, those that require surgery tend to have more significant injury pathology, a lower risk of recurrent instability after surgery, but a higher progression to osteoarthritis compared to patients that do not require surgical intervention. There was no difference in pain severity at final follow-up, rates of frozen shoulder or nerve palsy between patients who underwent initial nonoperative treatment after instability and those who underwent surgery. A history of multiple instability episodes prior to presentation was the greatest predictor of recurrent instability and failure of nonoperative treatment and progression to surgery. **Level of Evidence:** Level III, retrospective cohort study.

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Introduction

Anterior shoulder dislocations, once considered the provenance of the young and active, have been shown to be common in an older population.[1,2] Nearly 20% of all shoulder dislocations occur over the age of 60.[3] The incidence of first time anterior shoulder dislocation in patients over the age of 50 years ranges anywhere from 12.9 to 28.8/100,000 person years.[4] Older patients with anterior instability present with different injury patterns than compared to younger patients. Rotator cuff tears are very common;[5] however, recurrent instability is much less frequent in this age group.[3,6-8] These differences, as well as considerations about quality of life, create a unique set of considerations in regard to treatment of elderly patients.

For younger patients, surgical treatment, most commonly arthroscopic stabilization, is associated with significantly lower rates of recurrent instability.[9-18] While early surgery has been advocated for young patients after anterior shoulder instability events, there has been controversy in the literature over what type of treatment is best for older patients.[19,20] Studies have demonstrated that age >40 can be a risk factor for failure of the Bankart stabilization procedure.[21,22] Given the higher perioperative risks in this age population, and overall decreased rates of recurrent instability than their young peers, many authors advocate for nonoperative treatment for older patients. However, others have demonstrated that operative stabilization can result in a significantly reduced risk of recurrent instability.[23,24] Unfortunately, functional outcomes in the older population after surgical intervention are not as robust as in the young, with lower age related Constant scores than would be expected.[7] Surgical treatment in this age group is typically focused on rotator cuff integrity as opposed to shoulder-stabilizing operations, such as a Bankart or Latarjet procedure.[25] Overall, recommendations for treatment strategies after first-time anterior shoulder dislocation in the elderly population are lacking.

With recent changes in lifestyle and prolonged lifespans of the general population, these injuries are likely to be seen more commonly in the general orthopedist's office. Furthermore, the demands of this older population are higher than they once were. The purposes of the present study were to compare the clinical outcomes of operative and nonoperative management, identify risk factors for recurrent instability, and identify risk factors for progression to surgery after failed nonoperative management for patients with first time anterior shoulder dislocation after the age of 50 years. Our hypothesis is that that clinical outcomes after operative and nonoperative management for anterior shoulder instability after age 50 years are comparable; however, there is a decreased risk of recurrent instability after operative management.

Methods

Study Population and Design

The Rochester Epidemiology Project (REP) was used to identify patients who experienced anterior shoulder instability between January 1994 and July 2016 after institutional review board approval was obtained from both the Mayo Clinic and Olmsted Medical Center (16-007084 and 042-OMC-16). More than 500,000 patients comprise the included geographic region, complete with medical records of all residents in

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Olmsted County, Minnesota and neighboring counties in southeast Minnesota and western Wisconsin. The methodology and generalizability of the REP have previously been described in detail.[26,27] Patients were identified using International Classification of Diseases, Revision 9 (ICD-9) diagnosis codes for shoulder instability. All medical records were then manually reviewed to confirm the diagnosis, evaluate for eligibility, and obtain the necessary data. Inclusion criteria consisted of patients diagnosed with 1 or more anterior shoulder instability event(s), age >50 years at the time of initial instability, minimum of 2 years follow-up, and consent given for research. Exclusion criteria consisted of patients with multidirectional or posterior only shoulder instability, previous instability events occurring before the age of 50 years, or primary acromioclavicular/sternoclavicular joint dislocations.

Clinical Outcomes

Early surgical management was defined as intervention within 3 months of initial instability event. Delayed surgery (i.e., failure of nonoperative management) was defined as any patient having surgery ≥3 months after injury. Operative reports were reviewed for all patients who underwent surgical intervention. A number of surgical details were recorded, including approach (open versus arthroscopic), structures involved, structures repaired (rotator cuff tendons, labrum, fracture, etc.), and surgical technique. The main outcomes of interest were pain, development of adhesive capsulitis, development of nerve palsy, progression of osteoarthritis, and recurrent instability. Pain was graded on a patient-reported scale (none, mild, moderate, and severe) at final follow-up. The diagnoses of adhesive capsulitis and nerve palsy were made by an orthopedic provider with objective measurements, such as range of motion and muscle strength/sensation. Osteoarthritis was graded by the primary author (AS) using the Samilson and Prieto grading system for post-instability arthritis. Any patient with grade 1-3 changes was considered to have arthritis. The diagnosis of recurrent dislocation or subluxation was made by a consulting physician with accompanying radiographs.

Risk Factors

Patient medical records were reviewed to obtain patient characteristics and demographics (including age, sex, body mass index [BMI], occupation, previous surgery on affected shoulder). Previous instability events were included per physician report. Radiographs from the initial evaluation were reviewed by the primary author (A.S.) for any additional findings. In cases where the images were not available, the radiology report served as the basis for diagnosing pathology. Magnetic resonance (MR) images were reviewed by the primary author (A.S.). In cases where the images were not available, the radiology report served as the basis for diagnosing pathology. MR images and magnetic resonance imaging (MRI) reports were scrutinized for the presence of a rotator cuff tear, labral tear, bony Bankart lesion, Hill Sachs lesion, biceps tendon pathology, and glenohumeral ligament tear. The indications for obtaining an MRI were varied and provider-specific; however, the most common indications were residual shoulder pain and concern for rotator cuff tears.

Statistical Analysis

Data were summarized using means and standard deviations for continuous variables, and counts and percentages for categorical variables. Time-to-event outcomes, such as osteoarthritis and recurrent instability, were analyzed using survivorship methodology, including Kaplan-Meier estimation. Cox proportional hazards regression analysis was performed to evaluate potential risk factors, including, but not limited to, age, sex, any prior instability, and type of prior instability. The Cox models used the robust variance estimate to properly account for patients with bilateral involvement where applicable. Outcomes of pain, adhesive capsulitis, and nerve palsy were evaluated between those treated with surgery within 3 months of instability and those treated nonoperatively using Chi-square tests. All statistical tests were two-sided, and P values <.05 were considered statistically significant. All analyses were conducted using SAS version 9.4 (SAS Institute, Inc., Cary, NC).

Results

Patients

One-hundred and seventy-nine patients were diagnosed with first-time anterior shoulder instability after the age of 50 years and met all inclusion criteria. At the time of initial evaluation, 177 patients underwent radiographic evaluation. Images were not available for 47 of these patients. Of the total sample of 179 patients, 66 underwent MRI evaluation. Five were MR arthrograms, and 61 were traditional MRIs. Seventeen patients treated with operative management received an MRI at an average of 24 days after the initial injury (range: 4 days to 3 months), and 49 patients treated with conservative management received an MRI at an average of 51 months after the initial injury (range: 4 days to 13.1 years)." The mean age at the time of the initial instability event was 59.6 years (range: 50-70.5 years), and 54.2% of the cohort was female. The average follow-up was 10.8 years ± 6.6 years (range: 2-26.2 years). Mean BMI was 31.3 ± 7.1. The dominant shoulder was involved in 62.2% of all patients. 4.5% had previously had surgery on the same shoulder, and all of the previous surgeries performed were rotator cuff

repairs. 26.8% identified as laborers for their primary occupation. 153 patients (85.5%) were treated with an initial 3 months of nonoperative management. Twenty-six patients (14.5%) underwent early surgical management within 3 months of their injury. Overall, patients in the initial surgical management cohort presented with more severe pathology than their compatriots (Table 1). Of the patients that presented with a full-thickness rotator cuff tear (RCT), 50% of the initial surgical group and 42% of the initial nonoperative group had 2+ tendons involved. For 60% of the initial surgical group, the tear was acute in nature with no associated muscle atrophy, while only 26% of the initial nonoperative group had acute rotator cuff tears.

The average time to surgery for the early surgical management cohort was 37 days after initial instability event (range: 0-93 days). The most commonly performed surgical procedures included rotator cuff repair (65%; $n = 17$), anterior labral repair (19%; $n = 5$), and open reduction internal fixation (ORIF) of greater tuberosity fracture (12%; $n = 3$), and ORIF of proximal humerus fracture (12%; $n = 3$). Nineteen of the operations (73%) were arthroscopic, while 7 (27%) were open procedures. Four patients (15%) had recurrent instability events before surgical management at an average of 10 days after initial instability event (range: 1-19 days), but there were no instances of further instability after operative intervention.

Clinical Outcomes of Early Surgical and Nonoperative Management

Patients in the early surgical and nonoperative management groups did similarly at final follow-up, in terms of moderate-severe pain (19.2% vs 17.0%), incidence of frozen shoulder (7.7% vs 8.7%), and progression to osteoarthritis (20.1% vs 13.6%) (Table 2). Patients in the nonoperative cohort did develop osteoarthritis at a later time point, at an average of 7.4 years after their instability event compared to 2.8 years for the early surgical management group. There was an increased rate of nerve palsy in the early surgical management group (19.2% vs 8.1%; $P = .081$). The most commonly observed nerve palsy was brachial plexopathy. On average, patients saw drastic improvement 2.5 months after initial injury; however, slight weakness (grade 4/5 strength) often persisted for long after the dislocation event. 15% of the nonoperative cohort developed recurrent instability at an average of 3.3 years after their initial instability event (range: 2 days to 14 years). Fifteen percent of the operative cohort (4 patients) developed recurrent instability at an average of 10 days after their initial instability event (range: 1-19 days); however, there were no instances of recurrent instability after surgical intervention. Therefore, after surgical intervention, the early surgical management group was significantly less likely to have a recurrent shoulder dislocation compared to the nonoperative management group (0% vs 15%; $P = .03$).

Table 1. Patient and Injury Characteristics of the Nonoperative and Early Surgical Management Cohorts

	Early Surgical ($n = 26$) (*MRI: $n = 17$)	Nonoperative ($n = 153$) (*MRI: $n = 49$)	P Value
Average age at instability	59	59	
Underwent formal PT	42.3%	75.3%	.01
Humeral Head Fx	23.1%	8.5%	.03
Full-thickness RCT	82.3%	55.1%	.01
Labral tear	23.5%	8.0%	.01
Hill Sachs lesion	53.9%	49.6%	.69

Twenty-one patients in the nonoperative management group ultimately progressed to surgical intervention at an average of 4.6 years after initial dislocation event. Six patients underwent reverse/total shoulder arthroplasty at an average of 10.3 years after initial instability event. Eleven patients underwent a rotator cuff repair/debridement, while Bankart repair was performed for 3 patients. The final patient underwent an axillary nerve exploration and brachial plexus neurolysis.

Four patients in the early surgical management group required revision surgery: 2 patients underwent revision to shoulder arthroplasty at an average of 2.6 years after their initial instability event, 1 patient underwent a revision labral debridement and biceps tenodesis, and 1 underwent a hardware removal after a humeral head ORIF.

Risk Factors for Recurrent Instability After Initial Nonoperative Management

Multiple instability episodes were associated with an increased risk of further recurrent instability after initial nonoperative management (HR 232; $P < .01$). The presence of a glenoid fracture (HR 1.88), labral tear (HR 6.56), and glenohumeral ligament tear (HR 2.46) were associated with an increased risk of recurrent instability but did not reach statistical significance (Table 3).

Risk Factors for Progression to Surgery After Initial Nonoperative Management

Multiple instability episodes were also associated with an increased risk of progressing to surgical management after initial nonoperative management (HR 3.41; $P < .01$). The presence of a glenoid fracture (HR 2.59), glenohumeral ligament tear (HR 2.44), and Hill Sachs lesion (HR 1.95) were associated with an increased risk of progressing to surgical management but did not reach statistical significance (Table 3).

Discussion

The most important finding of this study was that patients who were diagnosed with first time anterior

Table 2. Clinical Outcomes of the Nonoperative and Early Surgical Management Cohorts

	Early surgical ($n = 26$)	Nonoperative ($n = 153$)	*P* Value
Moderate − Severe pain at follow-up	19%	17%	.78
Frozen shoulder	7.7%	8.7%	.87
Nerve palsy	19%	8.1%	.08
Recurrent instability	0%	15%	.03
Progression to osteoarthritis	20%	14%	.40
Progression to further surgical management	15%	14%	.82

shoulder instability after the age of 50 and treated with early surgical management had no further instances of instability after surgery. This is in spite of presenting with more severe pathology and developing progressive osteoarthritis at a faster rate than the nonoperative cohort. Fifteen percent of the nonoperative group developed recurrent instability. 14% of the nonoperative group ultimately progressed to surgical intervention at an average of 4.6 years after dislocation event. Overall, patients who were treated with either early surgical management or nonoperative management did well at final follow-up. Both cohorts had a similar prevalence of moderate-severe pain, frozen shoulder, nerve injury, and progression to osteoarthritis. Multiple instability events were a significant risk factor for both recurrence of instability and progression to surgery ($P < 0.001$, $P < 0.01$) in the nonoperative cohort.

In the present study, patients over the age of 50 years with a first-time dislocation did similarly in regard to persistent pain and complications with both initial operative and nonoperative management. About 20% of both cohorts reported moderate-severe pain at their final follow-up visit. This is a lower rate than found in other studies. Toolanen et al. found that 50% of patients over the age of 40 with first time dislocation were still symptomatic 3 years after the injury, and Hawkins et al. reported that 77% were still symptomatic 1.5 years after their initial dislocation.[28,29] The key difference between the current study and these others likely lies in length of follow-up, as we report an average of 11 years of follow-up. Longer-term outcomes of patients over the age of 50 years with first-time anterior shoulder dislocations appear to be more favorable than those previously reported. In general, nerve injuries are more common in the older patient with a first-time shoulder dislocation than their younger counterparts.[30] The axillary nerve is most commonly affected, with an incidence anywhere from 9.3% to 63% [6,8,28,30]. In our cohort, nerve palsy was diagnosed in 8.1% of the nonoperative cohort and 19.2% of the initial operative cohort. Frozen shoulder is also more common in older than younger patients after anterior shoulder instability.[31] This is thought to be potentially due to decreased activity in this population or age-related structural changes in the joint capsule after trauma.[32] Frozen shoulder occurred in 7.8% of the patients in the current study, and this rate was similar between treatment groups.

Patients who underwent initial surgical management had an increased risk of developing arthritis at an earlier time period compared to those that underwent initial conservative management. This is likely secondary to the increased severity of pathology that the patients presented with at the time of their initial injury. The surgical cohort patients were more likely to have a full-thickness rotator cuff tear or a fracture than the conservative management cohort. In general, surgical stabilization is not thought to be a cause of arthropathy unless it interferes with joint physiology.[16,21] Multiple studies have demonstrated that the risk of developing arthritis after an instability episode is most closely linked to the age of initial dislocation.[21,33] Patients greater than 50 years old

Table 3. Risk Factors for Recurrent Instability and Progression to Surgery After Initial Nonoperative Management

	Recurrent Instability ($n = 23$ Events)		Progression to Surgery ($n = 21$ Events)	
Risk factor	Hazard Ratio (95% CI)	*P* Value	Hazard Ratio	*P* Value
Age per +10 years	1.37 (0.74, 2.55)	0.32	0.54 (0.26, 1.15)	.11
Sex	0.75 (0.34, 1.69)	0.49	2.13 (0.82, 5.47)	.12
BMI per +1 pt	1.03 (0.97, 1.08)	0.37	1.04 (0.98, 1.10)	.21
Any Prior instability event	232.1 (13.15, 4095.3)*	<0.001	3.41 (1.45, 8.04)	<.01
Hill-Sachs on radiograph	0.53 (0.23, 1.23)	0.14	1.14 (0.48, 2.68)	.77
Glenoid Fracture on radiograph	1.88 (0.56, 6.25)	0.31	2.59 (0.59, 11.41)	.21
MRI findings				
Cuff tear	0.93 (0.11, 7.77)	0.95	0.98 (0.17, 5.51)	.98
Labral tear	6.56 (0.79, 54.68)	0.08	0.66 (0.25, 1.75)	.41
Bony Bankart	0.57 (0.07, 4.55)	0.60	0.62 (0.13, 2.90)	.55
Hill Sachs	1.52 (0.44, 5.29)	0.51	1.95 (0.63, 6.04)	.25
Biceps tendon pathology	1.10 (0.31, 3.85)	0.88	0.71 (0.28, 1.81)	.47
Glenohumeral ligament tear	2.46 (0.63, 9.67)	0.20	2.44 (0.86, 6.88)	.09

*HR based on Firth's penalized Cox regression analysis.

at the time of first anterior shoulder dislocation have a decreased rate of developing osteoarthritis compared to their younger compatriots under the age of 40 (14% vs 23 %).[17,34]

One of the major findings of the present study is that after early surgical management, older patients have a decreased risk of recurrent instability. Four patients in this cohort experienced recurrent instability events; however, all instances occurred before operative intervention; there were no further recurrent instability events that happened after surgery. For those that required surgery, the most common procedures were rotator cuff repairs, labral repairs, and fixation of glenoid rim fractures, and this is similar to previous reports. Maier et al. found that operative stabilization in the form of Bankart repair is equally as effective in reducing recurrent shoulder dislocation in the elderly as in the young.[7] However, Erstbrunner et al. found that arthroscopic Bankart repair for recurrent anterior instability in patients older than 40 without chronic rotator cuff pathology showed a 25% redislocation or resubluxation rate.[24] This contrasts with the work of Sperling et al., who examined a cohort of patients over the age of 50 years, who were treated with a Bankart repair. At 3 years, the patients had no recurrent instability events and presented with strong functional outcomes.[35] It also contrasts with the findings presented in the current study, which demonstrated no redislocation or resubluxation events after operative intervention, 42% of patients in this study, who presented with a full-thickness rotator cuff tear did not have the tear surgically fixed. Patients in the early surgical intervention group more commonly presented with acute tears, minimal muscular atrophy, and few degenerative changes. Patients in the initial nonoperative group with full-thickness rotator cuff tears typically did not obtain an MRI for months or years after their initial injury and more commonly presented with chronic rotator cuff pathology. Therefore, we would recommend that physicians obtain an MRI at an earlier time period for patients presenting with frank weakness, recurrent instability or persistent pain more than 4-6 weeks after an initial shoulder dislocation after the age of 50 years. Similar to our results, Simank et al. demonstrated that successful surgical management is possible for associated rotator cuff tears with anterior dislocation in patients over the age of 40, in terms of recurrent dislocations.[36] Additionally, an increase in constant scores has been reported in patients >40 who were treated with a rotator cuff repair.[37] Ultimate indications for undergoing rotator cuff tear repair in this age group would include acute change in function after shoulder dislocation event, recurrent instability in the setting of a reparable acute full-thickness rotator cuff tear with minimal muscular atrophy.

Similar to previous studies, the present study demonstrated that any previous instability event was a major risk factor for both progression to surgery and recurrent dislocation. Recurrent instability is a well-known entity in the young, active patient; however, it has been shown to be more prevalent in the elderly population than initially thought. Especially in the case of recurrent dislocations, surgical intervention could be considered in this population to help decrease the risk of further instability events.

Limitations

This work is restricted by the classic limitations of retrospective investigations. The decision to proceed to surgery and type of operation offered to the patient was not standardized across providers. Additionally, ~10% of all patients did not have complete follow-up information in regard to pain, adhesive capsulitis, and nerve palsy. Objective measures of range of motion and strength were not able to be consistently obtained across all patients. Despite the large number of patients in the overall study, there was a much smaller cohort that underwent surgical management, which could bias outcome measurements. This work is limited by the confines of a geographic database. Patients could have experienced recurrences of shoulder instability or sought surgical treatment outside of the database area, and those would not be accounted for in this study.

Conclusion

Although the majority of patients >50 years old that experience ASI are treated nonoperatively, those that require surgery tend to have more significant injury pathology and a lower risk of recurrent instability after surgery, but a higher progression to osteoarthritis compared to patients that do not require surgical intervention. There was no difference in pain severity, rates of adhesive capsulitis or nerve palsy between patients who underwent initial nonoperative treatment and those who underwent surgery. A history of multiple instability episodes prior to presentation was the greatest predictor of recurrent instability after treatment and failure of nonoperative treatment and progression to surgery.

References

1. Leland DP, Bernard CD, Keyt LK, et al. An age-based approach to anterior shoulder instability in patients under 40 years old: Analysis of a US population. *Am J Sports Med* 2020;48:56-62.
2. Leland DP, Parkes CW, Bernard CD, et al. Significant changes in the diagnosis, injury severity and treatment for anterior shoulder instability over time in a U.S. population. *Arthrosc Sports Med Rehabil* 2020;2:e761-e769.
3. Murthi AM, Ramirez MA. Shoulder dislocation in the older patient. *J Am Acad Orthop Surg* 2012;20:615-622.

4. Zacchilli MA, Owens BD. Epidemiology of shoulder dislocations presenting to emergency departments in the United States. *J Bone Joint Surg Am* 2010;92:542-549.
5. Hovelius L, Eriksson K, Fredin H, et al. Recurrences after initial dislocation of the shoulder. Results of a prospective study of treatment. *J Bone Joint Surg Am* 1983;65:343-349.
6. Gumina S, Postacchini F. Anterior dislocation of the shoulder in elderly patients. *J Bone Joint Surg Br* 1997;79:540-543.
7. Maier M, Geiger EV, Ilius C, Frank J, Marzi I. Midterm results after operatively stabilised shoulder dislocations in elderly patients. *Int Orthop* 2009;33:719-723.
8. Stayner LR, Cummings J, Andersen J, Jobe CM. Shoulder dislocations in patients older than 40 years of age. *Orthop Clin North Am* 2000;31:231-239.
9. Brophy RH, Marx RG. The treatment of traumatic anterior instability of the shoulder: Nonoperative and surgical treatment. *Arthroscopy* 2009;25:298-304.
10. Kuhn JE. Treating the initial anterior shoulder dislocation—An evidence-based medicine approach. *Sports Med Arthrosc Rev* 2006;14:192-198.
11. Chahal J, Marks PH, Macdonald PB, et al. Anatomic Bankart repair compared with nonoperative treatment and/or arthroscopic lavage for first-time traumatic shoulder dislocation. *Arthroscopy* 2012;28:565-575.
12. Grumet RC, Bach BR Jr, Provencher MT. Arthroscopic stabilization for first-time versus recurrent shoulder instability. Arthroscopy *Feb* 2010;26:239-248.
13. Jakobsen BW, Johannsen HV, Suder P, Sojbjerg JO. Primary repair versus conservative treatment of first-time traumatic anterior dislocation of the shoulder: a randomized study with 10-year follow-up. *Arthroscopy* 2007;23:118-123.
14. Kirkley A, Griffin S, Richards C, Miniaci A, Mohtadi N. Prospective randomized clinical trial comparing the effectiveness of immediate arthroscopic stabilization versus immobilization and rehabilitation in first traumatic anterior dislocations of the shoulder. *Arthroscopy* 1999;15:507-514.
15. Kirkley A, Werstine R, Ratjek A, Griffin S. Prospective randomized clinical trial comparing the effectiveness of immediate arthroscopic stabilization versus immobilization and rehabilitation in first traumatic anterior dislocations of the shoulder: Long-term evaluation. Arthroscopy *Jan* 2005;21:55-63.
16. Polyzois I, Dattani R, Gupta R, Levy O, Narvani AA. Traumatic first time shoulder dislocation: Surgery vs nonoperative treatment. *Arch Bone Jt Surg* 2016;4:104-108.
17. Lu Y, Pareek A, Wilbur RR, Leland DP, Krych AJ, Camp CL. Understanding anterior shoulder instability through machine learning: New models that predict recurrence, progression to surgery, and development of arthritis. *Orthop J Sports Med* 2021;9:23259671211053326.
18. Novakofski KD, Melugin HP, Leland DP, Bernard CD, Krych AJ, Camp CL. Nonoperative management of anterior shoulder instability can result in high rates of recurrent instability and pain at long-term follow-up. *J Shoulder Elbow Surg* 2022;31:352-358.
19. Chalidis B, Sachinis N, Dimitriou C, Papadopoulos P, Samoladas E, Pournaras J. Has the management of shoulder dislocation changed over time? *Int Orthop* 2007;31:385-389.
20. Itoi E, Hatakeyama Y, Sato T, et al. Immobilization in external rotation after shoulder dislocation reduces the risk of recurrence. A randomized controlled trial. *J Bone Joint Surg Am* 2007;89:2124-2131.
21. Hovelius L, Saeboe M. Neer Award 2008: Arthropathy after primary anterior shoulder dislocation—223 shoulders prospectively followed up for twenty-five years. *J Shoulder Elbow Surg* 2009;18:339-347.
22. Ladermann A, Lubbeke A, Stern R, Cunningham G, Bellotti V, Gazielly DF. Risk factors for dislocation arthropathy after Latarjet procedure: A long-term study. *Int Orthop* 2013;37:1093-1098.
23. Ernstbrunner L, Wartmann L, Zimmermann SM, Schenk P, Gerber C, Wieser K. Long-term results of the open Latarjet procedure for recurrent anterior shoulder instability in patients older than 40 years. *Am J Sports Med* 2019;47:3057-3064.
24. Ernstbrunner L, De Nard B, Olthof M, et al. Long-term results of the arthroscopic Bankart repair for recurrent anterior shoulder instability in patients older than 40 years: A comparison with the open Latarjet procedure. *Am J Sports Med* 2020;48:2090-2096.
25. Neviaser RJ, Neviaser TJ, Neviaser JS. Anterior dislocation of the shoulder and rotator cuff rupture. *Clin Orthop Relat Res* 1993;(291):103-106.
26. St Sauver JL, Grossardt BR, Yawn BP, et al. Data resource profile: The Rochester Epidemiology Project (REP) medical records-linkage system. *Int J Epidemiol* 2012;41:1614-1624.
27. St Sauver JL, Grossardt BR, Yawn BP, Melton LJ 3rd, Rocca WA. Use of a medical records linkage system to enumerate a dynamic population over time: The Rochester epidemiology project. *Am J Epidemiol* 2011;173:1059-1068.
28. Toolanen G, Hildingsson C, Hedlund T, Knibestol M, Oberg L. Early complications after anterior dislocation of the shoulder in patients over 40 years. An ultrasonographic and electromyographic study. *Acta Orthop Scand* 1993;64:549-552.
29. Hawkins RJ, Bell RH, Hawkins RH, Koppert GJ. Anterior dislocation of the shoulder in the older patient. *Clin Orthop Relat Res* 1986;206:192-195.
30. de Laat EA, Visser CP, Coene LN, Pahlplatz PV, Tavy DL. Nerve lesions in primary shoulder dislocations and humeral neck fractures. A prospective clinical and EMG study. *J Bone Joint Surg Br* 1994;76:381-383.
31. Harada Y, Iwahori Y, Kajita Y, Saito Y, Takahashi R, Deie M. Secondary frozen shoulder after traumatic anterior shoulder instability. *JSES Int* 2020;4:72-76.
32. Castagna A, Cesari E, Gigante A, Di Matteo B, Garofalo R, Porcellini G. Age-related changes of elastic fibers in shoulder capsule of patients with glenohumeral instability: A pilot study. *Biomed Res Int* 2018;2018:8961805.
33. Hovelius L, Augustini BG, Fredin H, Johansson O, Norlin R, Thorling J. Primary anterior dislocation of the shoulder in young patients. A ten-year prospective study. *J Bone Joint Surg Am* 1996;78:1677-1684.
34. Kruckeberg BM, Leland DP, Bernard CD, et al. Incidence of and risk factors for glenohumeral osteoarthritis after anterior shoulder instability: A US population-based study with average 15-year follow-up. *Orthop J Sports Med* 2020;8:2325967120962515.

35. Sperling JW, Duncan SF, Torchia ME, O'Driscoll SW, Cofield RH. Bankart repair in patients aged fifty years or greater: Results of arthroscopic and open repairs. *J Shoulder Elbow Surg* 2005;14:111-113.
36. Simank HG, Dauer G, Schneider S, Loew M. Incidence of rotator cuff tears in shoulder dislocations and results of therapy in older patients. *Arch Orthop Trauma Surg* 2006;126:235-240.
37. Porcellini G, Paladini P, Campi F, Paganelli M. Shoulder instability and related rotator cuff tears: Arthroscopic findings and treatment in patients aged 40 to 60 years. *Arthroscopy* 2006;22:270-276.