Evaluation and Management of Glenohumeral Instability in Adolescent Patients

An Expert Consensus Statement

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Background: Management of glenohumeral instability in the adolescent population can be both challenging and controversial. There are no current guidelines for optimal management of glenohumeral instability in this population (unidirectional or multidirectional), and the cutoff ages for transition to adult treatment are not known.

Purpose: To develop consensus-based guidelines for the management of glenohumeral instability in adolescents.

Study Design: Consensus statement.

Methods: A 26-question, multiple-choice survey was developed after 2 rounds of iterations and was submitted to the orthopaedic surgeons of the Pediatric Research in Sports Medicine (PRiSM) Society. The survey comprised 3 sections—demographics, practice setting, and decision-making—and included cutoff ages and management in 5 specific case scenarios. Consensus-based guidelines were generated with 66% response agreement. An indication score was then applied to each response related to more aggressive management to determine if variables related to consensus (or lack thereof) could be identified.

Results: A total of 54 responses were returned. Of the respondents, 59% were from academic practice, 84% were pediatric orthopaedic fellowship trained, and 46% performed >25 shoulder instability cases per year. In the setting of first-time anterior shoulder dislocation, nonoperative treatment was preferred for boys aged <14 years and girls aged <13 years. Besides age, proximal humerus physeal status, injury mechanism, sport, and presence of bony injury affected treatment selection. The presence of a Bankart lesion was an indication for stabilization in first-time dislocations for contact athletes with a closing or closed physis, but not in patients with an open physis or noncontact injury mechanisms. For recurrent anterior shoulder dislocation, stabilization was preferred irrespective of physis status. Initial nonoperative treatment was preferred for multidirectional instability.

Conclusion: In the setting of first-time anterior shoulder dislocation in patients with open physes, nonoperative treatment was preferred for boys <14 years and girls <13 years. Future multicenter prospective studies focusing on outcomes would help to validate current practice patterns, especially in scenarios for which no consensus was reached.

Keywords: shoulder; shoulder instability; pediatric sports medicine; anterior glenohumeral instability

Glenohumeral instability is a common source of pain and disability, with an incidence of 11 to 24 per 100,000 person-years in the general population.[12,44,46,55] The incidence is approximately 10 times higher in adolescent boys participating in contact sports, at 165 per 100,000 person-years.[33] Management of shoulder instability in the adolescent population is both challenging and somewhat controversial. Patients aged 12 to 18 years are at higher risk for recurrence compared with adult counterparts, with both nonoperative and operative treatment.[11,29,42,47]

One of the challenges of treating adolescent glenohumeral instability is the relative paucity of high-level clinical outcome data in this age group. Treatment recommendations are in part based on extrapolations from high-quality

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data in the young-adult population where the role of surgical treatment in recurrent instability is better studied. In skeletally mature patients, both arthroscopic and open stabilization procedures are effective in reducing the risk of recurrent instability, and in some cases early surgical treatment may be more cost-effective.[3,9,10,18,22] An Instability Severity Index Score has been validated for use in clinical decision-making regarding surgical treatment.[7,38]

There is growing recognition that adolescent glenohumeral instability has a distinct risk profile, a higher rate of atypical presentation, and different risk factors for recurrent instability compared with adult counterparts. The role of age in predicting recurrent instability is not clear; early studies suggested that the youngest patients were at highest risk for recurrence, while more recent publications suggest that adolescents aged 14 to 18 years are at higher risk than both older and younger patients.[27,35,37,39] Adolescent patients have a distinct profile of risk factors for recurrence, including open physes, decreased glenoid retroversion, and higher rates of atypical injuries such as anterior labroligamentous periosteal sleeve avulsions and off-track Hill-Sachs lesions.[11,28,32,54]

Despite a growing number of studies published on the subject, no standardized algorithm exists for evaluation and management. Therefore, potential controversy exists regarding the best approach to treat adolescents with glenohumeral instability. The purpose of this study was to establish consensus among age-specific specialists for the management of glenohumeral instability in adolescent patients.

METHODS

This study was held in conjunction with the Pediatric Research in Sports Medicine (PRiSM) Society's Shoulder Instability Research Interest Group (RIG). PRiSM is a health care society based in the United States whose members include athletic trainers, sports medicine physicians, physical therapists, surgeons, researchers, radiologists, nutritionists, nurse practitioners, and sports psychologists. PRiSM's goal to advance pediatric sports medicine research is achieved primarily through their RIGs, which focus on various disciplines. For the current study, a 26-question, multiple-choice survey was developed after 2 rounds of iterations by 2 members of the PRiSM Shoulder Instability RIG (C.W.N. and S.N.P.). The survey was distributed to the remaining RIG members to complete, and results were then discussed among all members of the RIG to determine which questions needed revision. The process was repeated with the second draft of the survey. After 2 rounds of edits, the investigators were satisfied with the questions and response options and sent the survey to the PRiSM Society at large.

The survey (Supplemental Material) comprised 3 sections: (1) respondent's demographics and practice setting (5 questions), (2) variables affecting the decision-making process including cutoff ages (1 question), and (3) management of 5 specific case scenarios (20 questions). Case scenarios focused on the consideration of several variables in recommending treatment for anterior glenohumeral instability, including age, physeal status, mechanism of injury, and number of dislocations. Similar case scenarios were included using the same methodology for multidirectional instability (MDI) to discern if this diagnosis itself changed management recommendations. For the purposes of the survey, an open surgery was considered to be open Bankart repair with capsular shift and not inclusive of bony augmentation (Latarjet procedure).

The survey was built in REDCap and was sent via email to orthopaedic surgeons of the entire PRiSM Society (131 surgeon members) on May 24, 2022. A follow-up email was sent July 2022. Based on a previously published study with similar methodology, consensus-based guidelines were generated when at least 66% of the respondents agreed.[34] For survey questions in which no consensus was reached, an analysis of the demographic factors was assessed for any factors that individually contributed to the lack of consensus.

To further analyze the respondents' likelihood to recommend surgical treatment for shoulder instability or to recommend a specific surgical procedure during operative treatment, 3 subscores were created for each respondent by summing the number of times they recommended surgery: an Open Indication Score, Anterior Indication Score, and MDI Indication Score. These 3 subscores may be considered a measure of the respondents' willingness to recommend surgery, or to recommend an open surgical procedure instead of an arthroscopic procedure, in clinical practice. The Open Indication Score summarizes the 14

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responses to questions based on 6 clinical vignettes for which an open surgical approach was an answer option, taking an ordinal value from 0 (never recommended open surgery) to 6 (always recommended open surgery). The Anterior Indication Score summarizes the 9 responses to the 4 clinical vignettes in the anterior shoulder instability section (cases 1-4), taking an ordinal value from 0 (never recommended surgery) to 9 (always recommended surgery). The MDI Indication Score summarizes the 5 responses to the 2 clinical vignettes in the MDI section, taking an ordinal value from 0 (never recommended surgery) to 5 (always recommended surgery).

Statistical Analysis

Basic descriptive statistics are reported as counts and percentages. When consensus was not reached, responses were compared using demographic data with Pearson chi-square to find associations between respondents and their answers. The Kruskal-Wallis H test was performed to test the indication subscores against survey respondent demographic factors. If there was a significant finding, then a pairwise comparison with Mann-Whitney U test was performed with Bonferroni correction to identify the demographic categories that were different from one another. Statistical analysis was conducted using SPSS (Version 28; IBM Corp). No a priori power analysis was performed. Statistical significance was defined as $P < .05$.

RESULTS

Survey Respondents

Of the 131 surgeon members of the PRiSM Society who received the survey, 54 (41%) completed it. The characteristics of the survey respondents are summarized in Table 1. All respondents were fellowship-trained orthopaedic surgeons, with most (43%) reporting fellowship training in pediatric orthopaedics, followed by fellowship training in both pediatric orthopaedics and sports medicine (41%). Most respondents (54%) reported performing <25 shoulder stabilization surgeries annually, and most (59%) practiced in an academic setting. The distribution of practices across the United States was even, and no respondents practiced outside of the United States. Ten respondents (19%) had practiced for <5 years, 16 (30%) reported 6 to 10 years in practice, 13 (24%) reported 11 to 15 years in practice, and 15 (28%) reported >15 years in practice.

Factors Associated With First-Time Anterior Dislocation

Respondents were asked whether a range of factors would influence their treatment decision for first-time anterior shoulder dislocations. A majority of respondents indicated that age (70%), presence of bony Bankart lesion (94%), mechanism of injury (70%), and sport/position played (76%) would influence their treatment decision to recommend surgical versus nonoperative treatment for a first-time anterior shoulder dislocation. Consensus was achieved for preferred nonoperative management of first-time anterior shoulder instability in male patients aged <14 years and female patients aged <13 years, with 67% of respondents each. A minority of respondents reported that their treatment decision for first-time shoulder dislocation would be influenced by patient sex (30%) or the presence of open physes (19%).

TABLE 1
Characteristics of the Survey Respondents

Characteristic	n	%
Fellowship type		
Sports medicine	9	17
Pediatrics	23	43
Both	22	41
Shoulder stabilization cases/y		
<25	29	54
26-50	19	35
51-100	6	11
Practice type		
Academic	32	59
Private	3	6
Mix	19	35
Practice location in United States		
East Coast	17	31
Midwest	10	19
South	15	28
West Coast	12	22
Years of experience		
<5	10	19
6-10	16	30
11-15	13	24
>15	15	28

Radiological Evaluation in First-Time Anterior Dislocation

Respondents indicated a preference for magnetic resonance imaging (MRI) in addition to plain radiographs in the evaluation of first-time dislocation. Overall, 46% indicated a preference for magnetic resonance arthrography (MRA), while 26% preferred MRI scans obtained with a 3-T magnet and 9% preferred MRI scans obtained with a 1.5-T magnet. One respondent (2%) preferred computed tomography (CT) for evaluation of first-time dislocation. Finally, 20% of respondents indicated that they did not routinely obtain advanced imaging for evaluation of first-time dislocation. Respondents were not allowed to choose multiple advanced imaging techniques (eg, CT and MRA).

Treatment Consensus

For first-time anterior dislocation, there was a consensus recommendation in favor of nonoperative treatment for patients with open physes and noncontact injury

TABLE 2
Consensus for Treatment Recommendations for Clinical Vignettes[a]

Scenario	Type of Instability	No. of Dislocations	Physis	Mechanism of Injury	Preferred Treatment
Case 1	Anterior	First	Closed/closing	Contact	Arthroscopic surgery
Case 2, item 12	Anterior	First	Open	Noncontact	Nonoperative
Case 4	Anterior	Multiple	Any	Any	Arthroscopic surgery
Case 5	MD	None	Open	Any	Nonoperative
Case 6, item 24	MD	Multiple	Any	Any	Arthroscopic capsulolabral plication with anchors and rotator interval closure

[a]MD, multidirectional.

TABLE 3
Lack of Consensus for Clinical Vignettes[a]

Scenario	Type of Instability	No. of Dislocations	Physis	Mechanism of Injury	Preferred Treatment
Case 1, item 9	Anterior	First	Open	Contact	NA
Case 3	Anterior	First	Closed/closing	Noncontact	NA
Case 6	MD	None	Closed/closing	Any	NA
Case 5, item 20	MD	First	Open	Any	NA

[a]MD, multidirectional; NA, not achieved.

mechanism (83% of respondents) (Table 2). However, there was no consensus for treatment recommendation in patients with open physes and a contact injury mechanism (40% favoring arthroscopic stabilization and 60% recommending nonoperative treatment) (Table 3). There was no consensus for the 2 scenarios of patients with closed or closing physes and a noncontact injury mechanism. Depending on the scenario, 50% to 57% of respondents preferred arthroscopic stabilization while 43% to 50% favored nonoperative treatment. However, there was a consensus recommendation in favor of operative treatment for first-time dislocation with closed or closing physes and a contact injury mechanism (with 69% of respondents favoring arthroscopic stabilization).

For patients with recurrent anterior dislocations, there was a consensus recommendation for arthroscopic stabilization regardless of physeal status or mechanism of injury. The vignette did not mention the presence or absence of glenoid bone loss. Of the respondents, 88% recommended arthroscopic surgery and 9% recommended open surgery, while only 3% recommended nonoperative treatment.

For MDI, there was consensus based on physeal status and number of dislocation events. There was a consensus recommendation in favor of nonoperative treatment of patients with symptomatic MDI with no history of frank dislocation, open physes, and a normal MRI/MRA scan (with 67% of respondents recommending nonoperative treatment and 31% recommending arthroscopic surgery). However, for patients with symptomatic MDI with no frank dislocations and closed or closing physes, there was no consensus for treatment (56% recommended surgery [50% arthroscopic, 6% open], and 44% recommended nonoperative treatment). This lack of consensus persisted in the scenario with a patient with MDI with a single dislocation episode and open physeal status, as 60% recommended surgery (54% arthroscopic, 6% open) and 41% recommended nonoperative treatment.

For patients with symptomatic MDI and history of multiple dislocations, there was a consensus recommendation for arthroscopic stabilization regardless of physeal status or mechanism of injury. The vignette did not mention the presence or absence of glenoid bone loss. Arthroscopic stabilization was recommended by 83%, open surgery by 13%, and nonoperative treatment by 4%. There was consensus regarding the surgical technique, with 83% recommending arthroscopic capsulolabral plication with suture anchors and 98% recommending rotator interval closure.

Factors Associated With Lack of Consensus

There was a relationship between the treatment recommendations for first-time anterior dislocations in female patients with closing growth plates and the surgeon's years in practice ($P = .042$), with 80% of respondents in practice for <5 years opting for nonoperative treatment, as opposed to 77% of respondents in practice for 11 to 15 years recommending arthroscopic stabilization. Surgeons with 6 to 10 years in practice recommended arthroscopic treatment 56% of the time, and surgeons with >15 years in practice recommended arthroscopic treatment 40% of the time. None of the respondents recommended open treatment.

There was a relationship between recommendation for open treatment and recurrent anterior instability in male patients with closed physis and the surgeon's years in practice ($P = .039$). Surgeons with >15 years in practice

TABLE 4
Distribution of the Open Indication Score by Surgeon Characteristics[a]

	Mean	Median	Range	P
Years of experience				**.017**
<5	0.2	0	0-2	
6-10	0.6	0	0-6	
11-15	0	0	0-0	
>15	1.3	0	0-5	
Practice type				.83
Academic	0.7	0	0-6	
Private	1	0	0-3	
Mixed	0.3	0	0-2	
Fellowship type				.451
Sports medicine	0.7	0	0-3	
Pediatrics	0.7	0	0-5	
Both	0.4	0	0-6	
Practice location				.234
East Coast	0.8	0	0-6	
Midwest	1.1	0	0-5	
South	0.1	0	0-1	
West Coast	0.5	0	0-3	
Cases/y				.068
<25	0.8	0	0-5	
26-50	0.4	0	0-6	
51-100	0	0	0-0	

[a]Boldface *P* value indicates a statistically significant difference according to characteristic ($P < .05$).

TABLE 5
Distribution of the Anterior Indication Score by Surgeon Characteristics[a]

	Mean	Median	Range	P
Years of experience				
<5	4.3	3	2-9	.241
6-10	6.1	7	2-9	
11-15	6.5	7	2-9	
>15	4.8	4	2-9	
Practice type				**.009**
Academic	4.8	5	2-9	
Private	8.7	9	8-9	
Mixed	6.2	7	2-9	
Fellowship type				.139
Sports medicine	6.2	6	2-9	
Pediatrics	4.7	5	2-9	
Both	6	7	2-9	
Practice location				.536
East Coast	5.9	7	2-9	
Midwest	4.5	4	2-8	
South	5.7	6	2-9	
West Coast	5.3	6	2-9	
Cases/y				.913
<25	5.3	5	2-9	
26-50	5.8	7	2-9	
51-100	5.3	6	2-8	

[a]Boldface *P* value indicates a statistically significant difference according to characteristic ($P < .05$).

recommended open treatment 27% of the time, while surgeons with <15 years in practice recommended open surgery 3% of the time. There were no other surgeon demographic factors related to treatment recommendations among survey items without a consensus response.

Assessment of Indication Scores

Table 4 shows the distribution of Open Indication Scores according to surgeon characteristics. There were significant differences in Open Indication Scores according to the surgeon's years in practice or years of experience (YOE) ($P = .017$); however, this association appeared to be weak, as none of the pairwise comparisons were found to be significantly different from each other ($P > .2$). Practice type, fellowship type, practice location, and cases per year were unrelated to the Open Indication Score.

The Anterior Indication Score appeared to be associated with a private practice setting, as private practice had a higher Anterior Indication Score than academic practice types ($P = .027$) (Table 5). The academic and mixed groups were similar ($P = .156$) to each other. Because of the low number of surgeons in private practice (n = 3), the private practice and mixed groups were combined, and the analysis was repeated. When combining private practice and mixed practice, the academic practice had a significantly lower Anterior Indication Score than the combined group ($P = .013$). In contrast to the Open Indication Score, experience seems to be unrelated to the Anterior Indication Score ($P = .241$).

Unlike the Open Indication Score and Anterior Indication Score, the MDI Indication Score was not associated with YOE ($P = .081$) or practice setting ($P = .743$) (Table 6). In fact, the MDI Indication Score was not associated with any of the demographic factors we assessed.

DISCUSSION

The management of anterior shoulder instability in adolescent patients continues to evolve. In our survey of providers who manage adolescent glenohumeral instability, there was a demonstrated consensus seen in the following scenarios:

- Overall, 83% recommended nonoperative treatment for first-time anterior instability in patients with open physes and a noncontact injury.
- Overall, 69% recommended arthroscopic stabilization for first-time anterior dislocation with closed/closing physes and a contact injury mechanism. This is a slight consensus, as it only just reaches the 66% threshold and would fail to be consensus if just 2 respondents changed their answers.
- Overall, 97% recommended surgical treatment of patients with recurrent anterior dislocations regardless of physeal status or mechanism of injury.

TABLE 6
Distribution of the MDI Indication Score by Surgeon Characteristics[a]

	Mean	Median	Range	*P*
Years of experience				.081
<5	2.1	1.5	1-5	
6-10	3.7	5	1-5	
11-15	2.4	2	0-5	
>15	3.1	3	1-5	
Practice type				.743
Academic	2.9	2.5	0-5	
Private	3.7	5	1-5	
Mixed	2.8	2	1-5	
Fellowship type				.213
Sports medicine	3.6	5	1-5	
Pediatrics	2.5	2	1-5	
Both	3.1	3.5	0-5	
Practice location				.645
East Coast	2.6	2	0-5	
Midwest	3.1	3.5	1-5	
South	2.7	2	1-5	
West Coast	3.4	4.5	1-5	
Cases/y				.113
<25	3.1	3	0-5	
26-50	2.3	1	0-5	
51-100	3.7	3.5	2-5	

[a]MDI, multidirectional instability.

- Overall, 67% recommended nonoperative treatment of patients with MDI, no history of dislocation, open physes, and normal MRI/MRA scans. This is a slight consensus, as it only just reaches the 66% threshold and would fail to be consensus if just 1 respondent changed their answer.
- Overall, 96% recommended surgical treatment of patients with MDI with multiple dislocations regardless of physeal status or mechanism of injury.

Despite consensus for these scenarios, disagreement remains for many common presentations of shoulder instability in patients regardless of provider. However, via the development of indication scores, there was an indication that years in practice (ie, YOE) influenced an interest in recommending open surgical procedures, and a private practice setting (including mixed-practice setting) influenced an interest in managing anterior shoulder instability with surgery.

The majority of respondents (80%) preferred an MRI scan in the evaluation of a first-time dislocation, with most preferring an arthrogram study. MRA can highlight more subtle intra-articular changes and has been shown to improve sensitivity for diagnosis of anterior and posterior labral tears compared with MRI alone.[2,45,53] Respondents did not frequently order CT scans as the first-line advanced imaging, but CT scans may be useful to more accurately quantify acute or attritional bone loss and the need for adjunct procedures to a Bankart repair.[40]

Consensus was achieved for preferred nonoperative management of first-time anterior shoulder instability in male patients aged <14 years and female patients aged <13 years. A systematic review and meta-analysis of risk factors for recurrent shoulder instability supports this consensus.[37] In evaluating 6 studies, the rate of recurrent shoulder instability was 73% in adolescent patients, with children aged 14 to 18 years being 2.4 times more likely to experience recurrent instability than those aged ≤13 years (93% vs 40%).[37] In evaluating 17 studies comparing nonoperative and operative management, patients <14 years in the primary nonoperative group were less likely to experience recurrence compared with those aged ≥14 years.[56] This may suggest a difference in outcomes between children and teenagers that could be further studied or a need to follow children longer to see if this risk changes when they become adolescents.

When consensus for surgical intervention was achieved, the majority of respondents preferred arthroscopic stabilization versus open repair. These findings are in line with the recent and predicted future national trends. In a large review of a national insurance database, arthroscopic stabilization (87%) was the most frequently utilized technique, far surpassing open Bankart repair (7%) in cases between 2007 and 2015.[41] In another large review, the number of open Bankart procedures decreased by 65% between 2009 and 2018, with future modeling predicting a further continued decline over the next 8 years.[1] This shift coincides with advancements in arthroscopic technique, instrumentation, and training over the past 20 years.[20] In the current study, only 3% of surgeons with ≤15 YOE recommended open repair compared with 27% of surgeons with >15 YOE. While prior studies had demonstrated superior results with open repair, more recent studies have shown no significant difference in the rate of recurrent instability or patient-reported outcomes between arthroscopic and open Bankart repair.[13,17,19,21,26,49] While several small case series have shown good results with open stabilization in adolescent patients, arthroscopic stabilization additionally has been shown to have a shorter operative time, improved postoperative range of motion, and decreased cost.[4,8,23,24,36] This represents another area of potential future study to determine if surgical approach (open vs arthroscopic with newer technologies) may change outcomes in this younger cohort.

MDI is a separate clinical presentation of pathological laxity characterized by instability in at least 2 directions.[6] MDI frequently has different physical examination and radiological findings compared with anterior instability. Features of MDI including high-grade laxity can be present in up to 20% of asymptomatic children and have a higher prevalence among swimmers and gymnasts.[4,16,25] Advanced imaging is more likely to show a patulous inferior capsule or be normal.[15,31] Nonoperative management with a minimum of 6 months of therapy and rehabilitation is often the first-line treatment for patients with MDI and can significantly improve functional outcomes.[30,50-52] Consensus for nonoperative management was noted in the current study for patients with MDI with open physes and was inconclusive for those with closed physes.[5,52] When nonoperative management fails, surgical management is often recommended. The present study shows consensus, with 96% of respondents recommending surgical

intervention for patients with MDI with recurrent instability regardless of age or physeal status. While historically the treatment included open inferior capsular shift, similar to anterior instability, the trend has shifted to arthroscopic stabilization.[6,43,48] In the current study, 83% recommended arthroscopic capsulolabral plication with suture anchors and 98% recommended complete rotator interval closure. Further study is needed to determine the role and benefit of surgical intervention in these patients.

Limitations

This study has several important limitations. First, consensus recommendations are based on expert opinion. The results presented here are intended to identify current management trends and determine where to best direct future research. Second, an anonymous survey method with a limited number of scenarios may oversimplify the problem and produce basic recommendations. Future research should be able to further detail factors that contribute to the lack of consensus. Third, while our survey response rate of 54 surgeons (41%) compares favorably to similar published response rates, there were low absolute numbers of respondents in some subcategories of practice settings.[14,34] Fourth, only surgeons from the United States were included in the survey. Fifth, survey respondents were not asked to provide rationale for their answers or what additional factors might change their answers. Sixth, consensus was barely reached for 2 responses, which makes those consensus statements fragile. Those 2 responses included (1) operative management of first-time dislocators with anterior instability, closed/closing physes, and a contact injury mechanism; and (2) nonoperative management of MDI without history of dislocation, normal MRI/MRA scan, and open physes. The survey was sent to the entire surgeon membership of PRiSM, some of whom may not actually manage anterior shoulder instability; thus, the limited response rate needs to be understood with that information as well.

CONCLUSION

Adolescent patients with shoulder instability are a unique and challenging group of patients who require treatment informed by the type of instability, number of dislocations, skeletal maturity, and mechanism of injury. While consensus was able to be reached on recommended treatment for certain clinical scenarios, including age cutoffs for nonoperative management and surgical intervention for recurrent instability, the study also demonstrates disagreement among experts in the treatment of numerous common clinical scenarios. Further research and understanding are needed for developing optimal treatment for many subsets of these patients.

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REFERENCES

1. Ahmed AS, Gabig AM, Dawes A, Gottschalk MB, Lamplot JD, Wagner ER. Trends and projections in surgical stabilization of glenohumeral instability in the United States from 2009 to 2030: rise of the Latarjet procedure and fall of open Bankart repair. *J Shoulder Elbow Surg*. 2023;32(8):e387-e395.
2. Ajuied A, McGarvey CP, Harb Z, Smith CC, Houghton RP, Corbett SA. Diagnosis of glenoid labral tears using 3-tesla MRI vs. 3-tesla MRA: a systematic review and meta-analysis. *Arch Orthop Trauma Surg*. 2018;138(5):699-709.
3. Arciero RA, Wheeler JH, Ryan JB, McBride JT. Arthroscopic Bankart repair versus nonoperative treatment for acute, initial anterior shoulder dislocations. *Am J Sports Med*. 1994;22(5):589-594.
4. Bak K, Wiesler ER, Poehling GG. Consensus statement on shoulder instability. *Arthroscopy*. 2010;26(2):249-255.
5. Bateman M, Smith BE, Osborne SE, Wilkes SR. Physiotherapy treatment for atraumatic recurrent shoulder instability: early results of a specific exercise protocol using pathology-specific outcome measures. *Shoulder Elbow*. 2015;7(4):282-288.
6. Best MJ, Tanaka MJ. Multidirectional instability of the shoulder: treatment options and considerations. *Sports Med Arthrosc Rev*. 2018;26(3):113-119.
7. Boileau P, Villalba M, Héry JY, Balg F, Ahrens P, Neyton L. Risk factors for recurrence of shoulder instability after arthroscopic Bankart repair. *J Bone Joint Surg Am*. 2006;88(8):1755-1763.
8. Bottoni CR, Smith EL, Berkowitz MJ, Towle RB, Moore JH. Arthroscopic versus open shoulder stabilization for recurrent anterior instability: a prospective randomized clinical trial. *Am J Sports Med*. 2006;34(11):1730-1737.
9. Bottoni CR, Wilckens JH, DeBerardino TM, et al. A prospective, randomized evaluation of arthroscopic stabilization versus nonoperative treatment in patients with acute, traumatic, first-time shoulder dislocations. *Am J Sports Med*. 2002;30(4):576-580.
10. Brophy RH, Marx RG. The treatment of traumatic anterior instability of the shoulder: nonoperative and surgical treatment. *Arthroscopy*. 2009;25(3):298-304.
11. Cheng TT, Edmonds EW, Bastrom TP, Pennock AT. Glenoid pathology, skeletal immaturity, and multiple preoperative instability events

are risk factors for recurrent anterior shoulder instability after arthroscopic stabilization in adolescent athletes. *Arthroscopy*. 2021;37(5):1427-1433.
12. Cleeman E, Flatow EL. Shoulder dislocations in the young patient. *Orthop Clin North Am*. 2000;31(2):217-229.
13. Cole BJ, Warner JJ. Arthroscopic versus open Bankart repair for traumatic anterior shoulder instability. *Clin Sports Med*. 2000;19(1):19-48.
14. Cook C, Heath F, Thompson RL. A meta-analysis of response rates in web- or internet-based surveys. *Educ Psychol Meas*. 2000;60(6):821-836.
15. Dewing CB, McCormick F, Bell SJ, et al. An analysis of capsular area in patients with anterior, posterior, and multidirectional shoulder instability. *Am J Sports Med*. 2008;36(3):515-522.
16. Emery RJ, Mullaji AB. Glenohumeral joint instability in normal adolescents. Incidence and significance. *J Bone Joint Surg Br*. 1991;73(3):406-408.
17. Fabbriciani C, Milano G, Demontis A, Fadda S, Ziranu F, Mulas PD. Arthroscopic versus open treatment of Bankart lesion of the shoulder: a prospective randomized study. *Arthroscopy*. 2004;20(5):456-462.
18. Franklin CC, Weiss JM. The natural history of pediatric and adolescent shoulder dislocation. *J Pediatr Orthop*. 2019;39(6 suppl 1):S50-S52.
19. Freedman KB, Smith AP, Romeo AA, Cole BJ, Bach BR. Open Bankart repair versus arthroscopic repair with transglenoid sutures or bioabsorbable tacks for recurrent anterior instability of the shoulder: a meta-analysis. *Am J Sports Med*. 2004;32(6):1520-1527.
20. Gao B, DeFroda S, Bokshan S, et al. Arthroscopic versus open Bankart repairs in recurrent anterior shoulder instability: a systematic review of the association between publication date and postoperative recurrent instability in systematic reviews. *Arthroscopy*. 2020;36(3):862-871.
21. Guanche CA, Quick DC, Sodergren KM, Buss DD. Arthroscopic versus open reconstruction of the shoulder in patients with isolated Bankart lesions. *Am J Sports Med*. 1996;24(2):144-148.
22. Handoll HHG, Almaiyah MA, Rangan A. Surgical versus non-surgical treatment for acute anterior shoulder dislocation. *Cochrane Database Syst Rev*. 2004;2004(1):CD004325.
23. Hatch MD, Hennrikus WL. The open Bankart repair for traumatic anterior shoulder instability in teenage athletes. *J Pediatr Orthop*. 2018;38(1):27-31.
24. Hickey IPM, Davey MS, Hurley ET, Gaafar M, Delaney RA, Mullett H. Return to play following open Bankart repair in collision athletes aged 18 years or less. *J Shoulder Elbow Surg*. 2022;31(6S):S8-S12.
25. Hinds N, Angioi M, Birn-Jeffery A, Twycross-Lewis R. A systematic review of shoulder injury prevalence, proportion, rate, type, onset, severity, mechanism and risk factors in female artistic gymnasts. *Phys Ther Sport*. 2019;35:106-115.
26. Hohmann E, Tetsworth K, Glatt V. Open versus arthroscopic surgical treatment for anterior shoulder dislocation: a comparative systematic review and meta-analysis over the past 20 years. *J Shoulder Elbow Surg*. 2017;26(10):1873-1880.
27. Hovelius L, Olofsson A, Sandström B, et al. Nonoperative treatment of primary anterior shoulder dislocation in patients forty years of age and younger. A prospective twenty-five-year follow-up. *J Bone Joint Surg Am*. 2008;90(5):945-952.
28. Hughes JL, Kruk P, Bastrom TP, Edmonds EW. Magnetic resonance imaging predictors of shoulder instability in adolescents. *Pediatr Radiol*. 2019;49(3):365-371.
29. Kawasaki T, Ota C, Urayama S, et al. Incidence of and risk factors for traumatic anterior shoulder dislocation: an epidemiologic study in high-school rugby players. *J Shoulder Elbow Surg*. 2014;23(11):1624-1630.
30. Kay J, Heyworth BE, Milewski MD, Kramer DE. Pediatric and adolescent shoulder instability. *Curr Rev Musculoskelet Med*. 2023;16(7):263-273.
31. Kjær BH, de Wandele I, Spanhove V, Juul-Kristensen B, Cools AM. Subacromial space outlet in female patients with multidirectional instability based on hypermobile Ehlers-Danlos syndrome and hypermobility spectrum disorder measured by ultrasound. *J Shoulder Elbow Surg*. 2020;29(3):600-608.
32. Lau BC, Conway D, Curran PF, Feeley BT, Pandya NK. Bipolar bone loss in patients with anterior shoulder dislocation: a comparison of adolescents versus adult patients. *Arthroscopy*. 2017;33(10):1755-1761.
33. Leroux TS, Saltzman BM, Meyer M, et al. The influence of evidence-based surgical indications and techniques on failure rates after arthroscopic shoulder stabilization in the contact or collision athlete with anterior shoulder instability. *Am J Sports Med*. 2017;45(5):1218-1225.
34. Liu JN, Steinhaus ME, Kalbian IL, et al. Patellar instability management: a survey of the International Patellofemoral Study Group. *Am J Sports Med*. 2018;46(13):3299-3306.
35. Marans HJ, Angel KR, Schemitsch EH, Wedge JH. The fate of traumatic anterior dislocation of the shoulder in children. *J Bone Joint Surg Am*. 1992;74(8):1242-1244.
36. Mohtadi NGH, Chan DS, Hollinshead RM, et al. A randomized clinical trial comparing open and arthroscopic stabilization for recurrent traumatic anterior shoulder instability: two-year follow-up with disease-specific quality-of-life outcomes. *J Bone Joint Surg Am*. 2014;96(5):353-360.
37. Olds M, Donaldson K, Ellis R, Kersten P. In children 18 years and under, what promotes recurrent shoulder instability after traumatic anterior shoulder dislocation? A systematic review and meta-analysis of risk factors. *Br J Sports Med*. 2016;50(18):1135-1141.
38. Phadnis J, Arnold C, Elmorsy A, Flannery M. Utility of the Instability Severity Index Score in predicting failure after arthroscopic anterior stabilization of the shoulder. *Am J Sports Med*. 2015;43(8):1983-1988.
39. Postacchini F, Gumina S, Cinotti G. Anterior shoulder dislocation in adolescents. *J Shoulder Elbow Surg*. 2000;9(6):470-474.
40. Provencher MT, Midtgaard KS, Owens BD, Tokish JM. Diagnosis and management of traumatic anterior shoulder instability. *J Am Acad Orthop Surg*. 2021;29(2):e51-e61.
41. Riff AJ, Frank RM, Sumner S, et al. Trends in shoulder stabilization techniques used in the United States based on a large private-payer database. *Orthop J Sports Med*. 2017;5(12):2325967117745511.
42. Roberts SB, Beattie N, McNiven ND, Robinson CM. The natural history of primary anterior dislocation of the glenohumeral joint in adolescence. *Bone Joint J*. 2015;97(4):520-526.
43. Şahin K, Kendirci AŞ, Albayrak MO, Sayer G, Erşen A. Multidirectional instability of the shoulder: surgical techniques and clinical outcome. *EFORT Open Rev*. 2022;7(11):772-781.
44. Shields DW, Jefferies JG, Brooksbank AJ, Millar N, Jenkins PJ. Epidemiology of glenohumeral dislocation and subsequent instability in an urban population. *J Shoulder Elbow Surg*. 2018;27(2):189-195.
45. Smith TO, Drew BT, Toms AP. A meta-analysis of the diagnostic test accuracy of MRA and MRI for the detection of glenoid labral injury. *Arch Orthop Trauma Surg*. 2012;132(7):905-919.
46. Smucny M, Kolmodin J, Saluan P. Shoulder and elbow injuries in the adolescent athlete. *Sports Med Arthrosc Rev*. 2016;24(4):188-194.
47. Torrance E, Clarke CJ, Monga P, Funk L, Walton MJ. Recurrence after arthroscopic labral repair for traumatic anterior instability in adolescent rugby and contact athletes. *Am J Sports Med*. 2018;46(12):2969-2974.
48. Vavken P, Tepolt FA, Kocher MS. Open inferior capsular shift for multidirectional shoulder instability in adolescents with generalized ligamentous hyperlaxity or Ehlers-Danlos syndrome. *J Shoulder Elbow Surg*. 2016;25(6):907-912.
49. Virk MS, Manzo RL, Cote M, et al. Comparison of time to recurrence of instability after open and arthroscopic Bankart repair techniques. *Orthop J Sports Med*. 2016;4(6):2325967116654114.
50. Warby SA, Ford JJ, Hahne AJ, et al. Comparison of 2 exercise rehabilitation programs for multidirectional instability of the glenohumeral joint: a randomized controlled trial. *Am J Sports Med*. 2018;46(1):87-97.
51. Watson L, Balster S, Lenssen R, Hoy G, Pizzari T. The effects of a conservative rehabilitation program for multidirectional instability of the shoulder. *J Shoulder Elbow Surg*. 2018;27(1):104-111.

52. Watson L, Warby S, Balster S, Lenssen R, Pizzari T. The treatment of multidirectional instability of the shoulder with a rehabilitation program: part 1. *Shoulder Elbow*. 2016;8(4):271-278.
53. Woertler K, Waldt S. MR imaging in sports-related glenohumeral instability. *Eur Radiol*. 2006;16(12):2622-2636.
54. Yamamoto N, Itoi E, Abe H, et al. Contact between the glenoid and the humeral head in abduction, external rotation, and horizontal extension: a new concept of glenoid track. *J Shoulder Elbow Surg*. 2007;16(5):649-656.
55. Zacchilli MA, Owens BD. Epidemiology of shoulder dislocations presenting to emergency departments in the United States. *J Bone Joint Surg Am*. 2010;92(3):542-549.
56. Zaremski JL, Galloza J, Sepulveda F, Vasilopoulos T, Micheo W, Herman DC. Recurrence and return to play after shoulder instability events in young and adolescent athletes: a systematic review and meta-analysis. *Br J Sports Med*. 2017;51(3):177-184.