The Epidemiology of Primary Anterior Shoulder Dislocations in Patients Aged 10 to 16 Years

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Background: Clinical studies of shoulder dislocations typically include adult patients (>16 years of age). Only small case series of patients aged 10 to 16 years are available to guide management.

Purpose: Using a cohort of patients aged 10 to 16 years, this study sought to determine (1) the incidence density rate (IDR) of primary anterior shoulder dislocations requiring closed reduction (CR) and (2) the rate of and risk factors for repeat shoulder CR.

Study Design: Cohort study (prognosis); Level of evidence, 2.

Methods: With use of administrative databases, patients aged 10 to 16 years who underwent CR of a primary anterior shoulder dislocation in Ontario, Canada, between April 2002 and September 2010 were gathered. IDRs for the entire cohort and demographic subgroups were calculated. The main outcome, repeat shoulder CR, was sought until September 2012. The cumulative incidence of repeat CR was calculated at multiple time points for the entire cohort and age subgroups. A competing risk model identified risk factors for repeat CR (reported as hazard ratios [HRs] with 95% CIs).

Results: There were 1937 patients aged 10 to 16 years who underwent primary CR (median age, 15.0 years; 79.7% male). The incidence of primary CR was highest among male patients aged 16 years (164.4 per 100,000 person-years), but primary dislocations were rare in 10- to 12-year-old children (n = 115; 5.9% of all dislocations). Repeat CR was observed in 740 patients (38.2%) after a median of 0.8 years; however, the rate of repeat CR was age dependent: it was highest among 14- to 16-year-old patients (37.2%-42.3%) and considerably lower among 10- to 13-year-old patients (0%-25.0%). Male sex (HR, 1.2 [95% CI, 1.0-1.5]; $P = .04$) and older patient age (HR, 1.2 [95% CI, 1.1-1.3]; $P < .001$) significantly increased the odds of repeat CR.

Conclusion: Among 14- to 16-year-old patients, the rate of primary and recurrent shoulder CR mirrors that of high-risk adults (17-20 years of age) from previously published data; however, the rate of shoulder CR (primary or recurrent) is considerably lower among 10- to 13-year-olds. In addition to older patient age, male sex increased the odds of repeat shoulder CR. Going forward, clinicians should counsel male patients and those aged 14 to 16 years regarding their increased risk of recurrence after the nonoperative management of a primary anterior shoulder dislocation.

Keywords: shoulder dislocation; recurrent instability; pediatric; epidemiology

Evidence suggests that patients younger than 20 years are at highest risk to sustain a primary anterior shoulder dislocation as well as develop recurrent glenohumeral instability[16,30]; however, most studies have excluded patients younger than 16 years. While it has been observed that shoulder dislocations are exceedingly rare in patients under 10 years of age,[30] evidence pertaining to patients aged 10 to 16 years is quite limited, and our understanding of shoulder dislocations in this patient demographic group stems from retrospective case series,[#] all of which have been criticized for their small size and study design limitations.[17] In fact, there is tremendous variability in the results of these studies, whereby the rate of redislocations in this demographic group has been reported to be anywhere from 0% to 100%.[#] In the absence of higher quality epidemiological data, it is likely that many of these patients are treated based on generalizations from adult data, possibly leading to overtreatment or undertreatment.

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[#]References 8, 9, 12, 13, 15, 18, 21, 23, 26, 27.

In an effort to fill this notable void in the literature, we developed a large cohort of patients aged 10 to 16 years from the general population and sought to (1) determine the overall and demographic-specific (age and sex) incidence of primary anterior shoulder dislocations requiring closed reduction (CR) and (2) determine the rate of and risk factors for repeat shoulder CR after the nonoperative management of a primary dislocation. Secondarily, we determined the rate of surgical stabilization in these younger patients.

METHODS

Databases

This study was a retrospective cohort study using data available through various health care registry databases in Ontario, Canada. Data were obtained through the following: (1) the Ontario Health Insurance Plan (OHIP) physicians' billing database, (2) the Registered Persons Database (RPD), (3) the Canadian Institute for Health Information (CIHI)–Discharge Abstract Database (DAD), and (4) the Institute for Clinical Evaluative Sciences (ICES) physicians' database. The public health care system of Ontario provides an opportunity to capture all patients who underwent physician-performed CR after a primary anterior shoulder dislocation, as no private institutions exist and all physician procedures of this type are recorded. Physician fee codes in the Province of Ontario have also demonstrated a high level of accuracy (>96%) on chart review.[29]

Study Design

With the use of the OHIP database and physician billing codes (see Appendix Table A1, available online at http://ajsm.sagepub.com/supplemental), we were able to identify all shoulder CR procedures performed on patients aged 10 to 16 years. The RPD allowed us to collect patient demographic information. The CIHI-DAD contains both diagnostic and procedural codes, via the use of the Canadian version of the International Statistical Classification of Diseases and Related Health Problems, 9th and 10th Revision (ICD-9-CA or ICD-10-CA), for every patient-hospital encounter in the province of Ontario. Furthermore, patients are anonymously linked between databases (eg, OHIP fee code and CIHI-DAD), facilitating the correlation between diagnoses and procedure(s). The ICES physician database contains pertinent physician demographic and training information that can be linked with each procedure.

The OHIP, RPD, and CIHI-DAD databases have been recording data since July 1991. These datasets are held and analyzed in encoded form at ICES (www.ices.on.ca), an independent nonprofit research organization funded by the Ontario Ministry of Health and Long-Term Care. Under Ontario's Personal Health Information Protection Act, individual patient consent is not required for research involving coded administrative health data.

Inclusion and Exclusion Criteria

As identified using the OHIP fee database, the index event was a first-time, physician-performed shoulder CR procedure in a patient aged 10 to 16 years between April 1, 2002 and September 1, 2010 (see Appendix Table A1). The included age range was selected based on (1) data suggesting that dislocations were exceedingly rare events below the age of 10 years[17] and (2) a prior publication by our group pertaining to the epidemiology of primary anterior shoulder dislocations in adult patients (>16 years of age).[16]

The exclusion criteria listed in Appendix Table A1 included any prior shoulder CR or shoulder stabilization (OHIP), any posterior shoulder dislocation (ICD-10), any prior shoulder arthroplasty (OHIP), and a concomitant humeral fracture (OHIP). Furthermore, patients who were non-Ontario residents were also excluded, as accurate long-term follow-up of these patients would not be possible. Exclusion criteria were applied using a minimum 10-year look-back period for all patients (from the index date to the start of the OHIP database [July 1991]).

Outcomes

The main outcome in this study was repeat shoulder CR; a secondary outcome was shoulder stabilization (Appendix Table A1). Either outcome was identified any time between the index event and study end date (September 1, 2012), and each patient was followed for a minimum of 2 years. Censoring events included patient death, emigration, lost OHIP coverage, or a shoulder stabilization procedure. Of note, database limitations precluded the determination of

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laterality for either outcome, and subluxations or self/spontaneous reductions of dislocations could not be captured.

Covariates

Patient Factors. Each patient who underwent physician-performed shoulder CR had demographic data (age, sex, and neighborhood median household income quintile) recorded at the time of the index event. Patient age was collected as a continuous variable. Income quintile was estimated using census data from Statistics Canada. As previously established,[2,16] the home postal code was used to estimate the income per single-person equivalent of that geographic region as reported by Statistics Canada; results were classified into quintiles as per Statistics Canada data reflecting the entire Canadian population (http://www.statcan.gc.ca/pub/75-202-x/2009000/analysis-analyses-eng.html).

Using the technique of collapsed aggregated diagnostic groups (CADG),[14] a baseline comorbidity score was determined for each patient. This methodology uses ICD-9/ICD-10 data to identify patient interactions with the health care system in similar domains of illness/condition and health care resource utilization. A 3-year look back to calculate the CADG score was used. An overall CADG score is then determined (a surrogate for overall comorbidity), and patients were stratified according to this score (low: 0-5; high: 6-12).

Provider Factors. The provider factor assessed in this study was the field of specialty of the physician performing the index CR procedure. Physician specialty was determined based on Royal College of Physicians and Surgeons of Canada certification in the OHIP physician database. This was a binary classification: either orthopaedic surgeon or "other" specialties, including emergency medicine specialists, pediatricians, family/general practitioners, internal medicine practitioners, physiatrists, or general surgeons (Appendix Table A1).

Data Analysis

Statistical comparisons were made between patients who had a subsequent anterior shoulder dislocation(s) requiring CR and those patients who did not. All continuous variables were analyzed using 2-tailed t tests and categorical variables using the χ^2 test.

An overall (mean) and annual incidence density rate (IDR) (per 100,000 person-years) of primary anterior shoulder dislocations requiring CR was determined for the entire cohort and each demographic subgroup. A subgroup was created for each of the following demographic categories: age (10, 11, 12, 13, 14, 15, and 16 years), sex (male and female), and combinations of sex and age.

The IDR was calculated by comparing the annual incidence of primary anterior shoulder dislocations requiring CR (numerator) with all eligible Ontario residents for that same time period (denominator). Eligible residents had valid OHIP coverage and were 10 to 16 years of age. To obtain the most accurate assessment of the at-risk population, fractional contributions were calculated for any person who lost or gained eligibility between January 1 and December 31. The overall IDR was determined by averaging the annual IDRs from full study years (2003-2009). A similar methodology was used to determine the IDR for each age, sex, and age-sex category. Additionally, IDR ratios were generated to compare IDRs between demographic subgroups, and a Poisson model was used to determine significance.

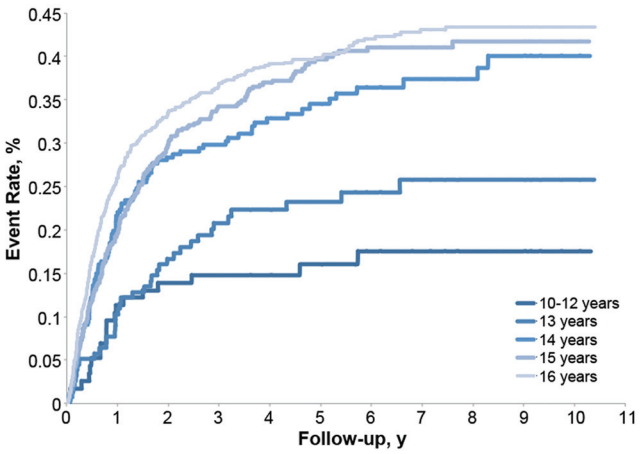

Figure 1. Cumulative incidence of repeat shoulder closed reduction (CR) by age subgroup. The event rate of repeat shoulder CR was calculated by comparing the number of patients who have undergone first-time repeat shoulder CR (numerator) to all eligible study patients, excluding those who have been censored for emigration, death, loss of Ontario Health Insurance Plan coverage, and shoulder stabilization surgery (denominator).

A time-to-event analysis (cumulative incidence function) was used to identify repeat shoulder CR from the index date until the end of data collection (September 1, 2012) for both the overall cohort and age subgroups (10-12, 13, 14, 15, and 16 years). Given the low rates of repeat shoulder CR among patients aged 10-12 years and privacy regulations at the Ministry of Health in Ontario (cannot publish data with <6 patients), a post hoc decision was made to group these patients during the time-to-event analysis. The cumulative incidence of first repeat shoulder CR was calculated and reported at 6 months, 1 year, 2 years, and 5 years. Censoring events were taken into consideration in this model, including emigration from Ontario, loss of OHIP coverage, shoulder stabilization surgery, and death.

A competing risk model was created to assess for the influence of the aforementioned patient, injury, and provider factors on the risk of repeat dislocations requiring CR. Age was analyzed as a continuous variable, and reference values for categorical variables included the median (income: third quintile) or most common categories (male sex, CADG score 0-4, urban neighborhood, and non–orthopaedic specialist). The influence of these covariates on the main outcome was quantified using hazard ratios (HRs) with 95% CIs. All statistical analyses were performed using SAS v9.1 for UNIX (SAS Institute), and α values for all statistical analyses were defined a priori at .05.

TABLE 1
Cohort Exclusion Criteria

	n
Cohort size (before exclusion)	2066
Exclusion criteria	
Non–Ontario resident/missing demographic data	21
Posterior shoulder dislocation	22
Prior shoulder stabilization or any shoulder replacement	8
Prior closed reduction of the shoulder	52
Concurrent humerus fracture	26
Cohort size (after exclusion)	1937

TABLE 2
Cohort Demographic Information (N = 1937)[a]

	Values
Age, y	
Mean ± SD	14.90 ± 1.29
Median (IQR)	15 (14-16)
Sex	
Male	1543 (79.7)
Female	394 (20.3)
CADG score	
<4	1605 (82.9)
≥5	332 (17.1)
Neighborhood	
Rural	236 (12.2)
Urban	1701 (87.8)
Income quintile[b]	
1	243 (12.5)
2	329 (17.0)
3	387 (20.0)
4	447 (23.1)
5	531 (27.4)

[a]Data are reported as n (%) unless otherwise indicated. CADG, collapsed aggregated diagnostic groups; IQR, interquartile range.
[b]http://www.statcan.gc.ca/pub/75-202-x/2009000/analysis-analyses-eng.html.

RESULTS

We identified 2066 patients aged 10 to 16 years who underwent physician-performed CR after a primary anterior shoulder dislocation. After application of the exclusion criteria (Table 1), 1937 patients were included in this study. The median patient age was 15.0 years (interquartile range [IQR], 14.0-16.0 years), and 79.7% were male. Complete cohort demographic data are listed in Table 2.

The overall IDR of primary anterior shoulder dislocations was 20.1 per 100,000 person-years. The IDR among male patients was significantly greater than that of female patients (31.0 vs 8.2 per 100,000 person-years, respectively; $P < .0001$). The IDR also varied considerably depending on age and sex combinations (Table 3). For instance, the IDR was greatest among male patients aged 16 years (164.4 per 100,000 person-years) but lowest among female patients aged 10 years (1.3 per 100,000 person-years). The overall number of primary and repeat shoulder CR procedures by age and sex is depicted in Appendix Table A2 (available online).

TABLE 3
Incidence Density Rate of Primary Shoulder Closed Reduction by Demographic Subgroup

Subgroup	Incidence Density Rate (per 100,000 Person-Years)
Sex	
Male	31.0
Female	8.2
Age, y	
10	1.85
11	2.05
12	4.38
13	9.61
14	17.40
15	32.72
16	96.95
Sex and age	
Female	
10 y	1.30
11 y	1.40
12 y	3.55
13 y	7.74
14 y	9.44
15 y	11.91
16 y	26.65
Male	
10 y	2.38
11 y	2.66
12 y	5.17
13 y	11.39
14 y	24.96
15 y	52.53
16 y	164.42

In total, 38.2% of the patients (n = 740) underwent at least 1 repeat shoulder CR procedure during the study period, of which 52.2% had ≥2 repeat events. The median time to first repeat shoulder CR was 0.8 years (IQR, 0.4-1.8 years), and the overall cumulative incidence of repeat shoulder CR at 6 months and 1, 2, and 5 years after a primary anterior shoulder dislocation was 13.0%, 21.3%, 29.2%, and 36.2%, respectively. As illustrated in the cumulative incidence plots by age subgroup (Figure 1), the rate of repeat shoulder CR was greatest among patients aged 16 years (42.3%) and lowest among patients aged 10 to 12 years (17.4%). Furthermore, as depicted in Figures 1 and 2, the rate of repeat shoulder CR was similar among patients aged 14 to 16 years (14 years: 37.2%; 15 years: 40.8%; 16 years: 42.3%), and these rates were considerably greater than those for patients aged 13 years or younger (10-12 years: 0-22.1%; 13 years: 25.0%). Overall, 95% and 99% of all first-time repeat shoulder CR procedures occurred within 4.4 and 5.3 years of the index event, respectively.

As compared with patients who did not undergo repeat shoulder CR, patients who did were significantly older (15.1 ± 1.1 years vs 14.8 ± 1.4 years, respectively; $P <$

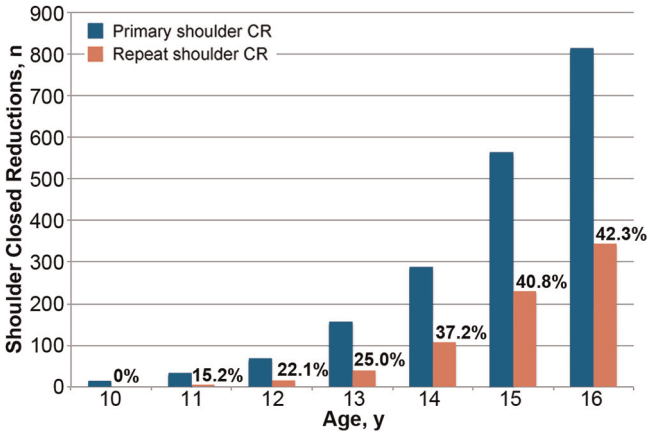

Figure 2. Age-specific distribution of primary and repeat shoulder closed reduction (CR) procedures. The rate of repeat shoulder CR was defined as the proportion of the patients who underwent repeat shoulder CR as compared with the number who underwent primary shoulder CR.

.001), and a significantly greater proportion were male (83.4% vs 77.4%, respectively; $P = .001$). In fact, as depicted in Table 4, each additional year of age carried a 20% increased odds of repeat shoulder CR when compared with a patient aged 1 year younger (HR, 1.2 [95% CI, 1.1-1.3]; $P < .001$), and male patients had 20% increased odds of repeat shoulder CR as compared with female patients (HR, 1.2 [95% CI, 1.0-1.5]; $P = .04$). No other patient (comorbidity or income quintile) or provider factor (physician type performing primary shoulder CR) significantly influenced the risk (Table 4).

Overall, 31.2% (n = 604) of patients underwent shoulder stabilization. Of those patients who had a repeat dislocation, 49.9% eventually underwent stabilization (n = 369). This proportion was statistically significantly greater ($P < .001$) than the proportion of patients who underwent stabilization after only the index CR procedure (19.6%; n = 235). The median time to shoulder stabilization after a primary anterior shoulder dislocation requiring CR was 1.9 years (IQR, 0.7-2.4 years).

DISCUSSION

This is the first population-based study to report on the epidemiology of primary anterior shoulder dislocations in patients aged 10 to 16 years. Although the overall IDR of primary shoulder CR was 20.1 per 100,000 person-years, and similar to that of adult patients (>16 years of age),[16,30] the vast majority of these events occurred in male patients (79.8%; n = 1298) and those aged 14 to 16 years (85.9%; n = 1397). In fact, male sex (HR, 1.2 [95% CI, 1.0-1.5]; $P = .04$) and older patient age (HR, 1.2 [95% CI, 1.1-1.3]; $P < .001$) were significant risk factors for repeat shoulder CR in this patient cohort. Interestingly, the rate of repeat shoulder CR among patients aged 14 to 16 years (37.2%-42.3%) was considerably greater than that for patients aged 13 years or younger (0%-25%).

TABLE 4
Competing Risk Model: Risk Factors for Repeat Closed Reduction[a]

Variable	Hazard Ratio (95% CI)	*P* Value
Age: older vs younger	1.21 (1.14-1.29)	**<.001**
Sex: male vs female	1.23 (1.01-1.49)	**.04**
Income quintile		
1 vs 3	1.17 (0.90-1.53)	.25
2 vs 3	0.98 (0.77-1.26)	.88
4 vs 3	1.10 (0.88-1.38)	.40
5 vs 3	0.99 (0.79-1.24)	.95
CADG score: ≥5 vs 0-4	0.96 (0.79-1.18)	.72
Neighborhood: urban vs rural	1.06 (0.84-1.33)	.64
Index physician subspecialty: orthopaedic surgeon vs other	0.69 (0.43-1.07)	.10

[a]Bolded values indicate a statistically significant difference between variables compared ($P < .05$). CADG, collapsed aggregated diagnostic groups.

It has repeatedly been shown that young age (<20 years) is a significant risk factor for the development of recurrent glenohumeral instability.[16,17,19,20,22,25,30] On the other hand, most studies exclude patients younger than 16 years, and there is obvious uncertainty regarding the extrapolation of this evidence to younger pediatric patients.[17] In a large epidemiology study of shoulder dislocations in the United States, patients younger than 16 years were included, but a specific subgroup analysis of these younger patients was not undertaken, and their conclusions reflect a combination of adult and pediatric patients.[30] Among the few small, retrospective case series that have reported outcomes after the treatment of primary anterior shoulder dislocations in patients younger than 16 years,[17] the rate of recurrence appears to be high (upward of 100%)[18]; however, it remains unclear if this heightened risk is applicable to all patients younger than 16 years or if an age-dependent variation in risk exists. In a recent review article for the *Journal of the American Academy of Orthopaedic Surgeons* (JAAOS), the authors found a higher rate of recurrent glenohumeral instability in patients aged 14 years or older and provided a level V recommendation that clinicians manage these patients as they would adult patients, including a consideration for early stabilization.[17] In the present study, we also found that patients aged 14 to 16 years demonstrated an increased risk of recurrent glenohumeral instability (37.2%-42.3%), and although the rate of repeat shoulder CR in these patients was not as high as had been previously reported, it was in keeping with the rate of repeat shoulder CR among patients aged 17 to 20 years from the same geographic region (38.2%).[16] This observation supports the aforementioned JAAOS recommendation,[17] and we agree that patients aged 14 years or older should be counseled regarding their increased risk and consideration be given to managing these patients similarly to other high-risk patients.

The risk of recurrent glenohumeral instability in patients younger than 14 years is not well described in

the literature, but it appears to be exceedingly low for patients younger than 10 years.[1,17,30] In the intervening age group, 10 to 13 years, the reported rate of recurrence has varied from 0%[15] to 53%,[8] a likely reflection of the small cohort sizes of past studies (largest series was 15 patients). Of the 271 patients aged 10 to 13 years in our cohort, less than a quarter underwent repeat shoulder CR, and the risk diminished considerably with decreasing age (0% among 10-year-old patients vs 25% among 13-year-old patients). As compared with patients aged 14 to 16 years, there appears to be a considerably lower risk for these younger patients, which we speculate may reflect underlying anatomic differences (the glenohumeral capsule in skeletally immature patients has been found to be more elastic[8,21] and resilient to tears[8,21]), differences in labral injuries after a glenohumeral dislocation (anteroinferior labral tears are not commonly observed in skeletally immature patients who sustain an anterior shoulder dislocation[6,17,21] which likely reflects protection conferred by the aforementioned elasticity of the capsulolabral complex[17]), and differences in activity level and sport type (increasing involvement in contact sports with older age[22,24]). Ultimately, future studies are needed to delineate the factors contributing to this age-dependent difference in risk, which was beyond the resolution of our database.

In the adult literature (patients aged >16 years), male sex has been implicated as a significant risk factor for the development of glenohumeral instability.[16,22] To the best of our knowledge, a similar observation for younger patients has not been made. In our cohort of patients aged 10 to 16 years, we observed that male patients had 20% increased odds of repeat shoulder CR as compared with female patients. We speculate that this sex-specific difference in risk may reflect variations in sport type (male patients may be more likely to participate in contact sports, which have been shown to increase the recurrence risk[22,24]) and compliance; however, further investigation is needed to substantiate these theories.

The management of a primary anterior shoulder dislocation in a high-risk patient is controversial[3-5,7,11,28] but typically includes either immobilization or early stabilization. Among patients aged 10 to 16 years, the role of early stabilization is not well understoood.[17] Despite this, we observed that 19.6% of patients aged 10 to 16 years underwent stabilization after only the primary shoulder CR procedure (no documented repeat shoulder CR). This was surprising given the relative paucity of data pertaining to shoulder stabilization procedures in patients aged under 16 years; however, we speculate that it may reflect unrecognized morbidity in these younger patients after nonoperative management, such as dissatisfaction or failure to return to sport (eg, ongoing apprehension), ongoing instability events not requiring physician reduction (self/spontaneous reductions or subluxation events), or a bias among surgeons toward the early stabilization of patients whom they perceive to be high risk. Going forward, there is a certain need to determine the efficacy of various treatments for higher risk young patients (male patients aged 14-16 years), whom we and other authors[17] believe may see benefits from early stabilization.

Limitations

In this study, we used physician-performed shoulder CR as a surrogate for a shoulder dislocation, and we could not report instability events such as subluxations and spontaneous reductions as they are beyond the resolution of this database. As such, the rate of recurrence that we report in this study may underestimate the true prevalence of recurrent symptomatic glenohumeral instability in patients aged 10 to 16 years.

Although we defined primary dislocation events using a look-back window of at least 11 years, it remains possible that without a chart review (beyond the feasibility of this study), we may have misclassified some recurrent events as primary dislocations. Despite this, we demonstrated that >99% of all repeat shoulder CR procedures occur within 5.3 years of the primary dislocation, and we remain confident that the risk of mislabeling is negligible.

Laterality could not be determined in our database, and as mentioned above, a chart review was not feasible because of costs associated with a cohort of this size and geographic spread. Although it remains possible that a proportion of repeat shoulder CR procedures were in fact primary contralateral shoulder CR procedures, the rate of contralateral shoulder dislocations is infrequently reported throughout the literature, and our understanding is limited to studies of heterogeneous patient populations that suggest the rate to be between 9% at 5 years[25] and 12% at 10 years.[13]

The administrative databases used in this study limited the scope of our risk factor analysis. In particular, factors such as mechanism of injury (traumatic vs atraumatic), reduction technique, presence of glenoid or humeral bone loss, course of nonoperative treatment (length and position of immobilization), occupation, and activity level could not be assessed. On the other hand, a recent Cochrane review did not find that immobilization position (internal vs external rotation) and duration of immobilization significantly influenced the recurrence risk,[10] which lends credibility to the use of general population data, where variations in treatment are likely to occur, to study recurrence after nonoperative management.

Lastly, an important consideration is the variation in skeletal development among patients aged 10 to 16 years. When applying our established age cutoff values, clinicians should consider both the chronological and physiological age of the patient. Although not presently well established, future research may reveal a difference in recurrence risk based on the integrity of the physis (open vs closed), and physicians should be mindful of skeletal maturity when assessing these younger patients with recurrent glenohumeral instability.

CONCLUSION

After nonoperative management, repeat shoulder CR was common among 14- to 16-year-old patients (37.2%-42.3%), and in fact, the rate of recurrence in this age group mirrors that of 17- to 20-year-old patients from previously

published data (38.2%)[16]; however, both the incidence of primary and repeat shoulder CR procedures were considerably lower for patients aged 10 to 13 years (0%-25%). In addition to patient age, male sex also increased the risk of repeat shoulder CR. Going forward, the results of this study can be used by clinicians to educate young patients regarding their future risk of recurrence after the nonoperative management of a primary anterior shoulder dislocation, particularly those patients at greatest risk: male patients and those aged 14 to 16 years. Future studies should further examine the observed age-dependent variation in risk and determine the efficacy of various treatments in this young patient population, including early stabilization. Finally, our findings suggest that investigators of future studies pertaining to glenohumeral instability should consider the inclusion of patients as young as 14 years old as opposed to the common age cutoff value of 16 years.

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