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Intermediate Outcomes After Primary Traumatic Anterior Shoulder Dislocation in Skeletally Immature Patients Aged 10 to 13 Years

KEITH CORDISCHI, DO; XINNING LI, MD; BRIAN BUSCONI, MD

abstract

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A paucity of literature exists regarding the outcome of skeletally immature patients who sustain a primary traumatic anterior shoulder dislocation. Most published results focus on adolescents and young adults, using recurrent dislocation/instability as a determinant of outcome, rather than a validated quality of life measurement tool. The purpose of this study is to assess the intermediate term functional outcome after anterior traumatic shoulder dislocation in the skeletally immature patient population. Fourteen patients (age range, 10.9-13.1 years; 14 shoulders) who sustained a primary anterior traumatic unidirectional shoulder dislocation were included. Each patient underwent successful documented closed reduction of the dislocated shoulder and was subsequently treated with initial nonsurgical intervention. All patients were monitored in the clinic routinely, until skeletal maturity was reached. The Western Ontario Shoulder Instability index (WOSI), range of motion, complications, and recurrent dislocations were recorded. The average WOSI score for all patients at the time of injury was 1635 (range, 1550-1690). At final follow-up (mean, 5.6 years), the average WOSI score for all patients was 39.6 (range, 0-195). Subgroup analysis revealed that those treated nonoperatively fared better than their operative counterparts (average final follow-up WOSI score, 9.1 vs 151.7, respectively). Three patients (21.4%) ultimately sustained a recurrent shoulder dislocation that necessitated surgical intervention. Based on the above data, in the pediatric skeletally immature patient who sustained a primary, traumatic, anterior shoulder dislocation, nonoperative treatment results in low shoulder instability recurrence risk and sound functional outcomes.

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Drs Cordischi, Li, and Busconi FINANCIAL DISCLOSURES.

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It has been estimated that less than 2% of all traumatic glenohumeral dislocations occur in patients younger than 10 years of age. In addition, only about 20% occur in individuals between the ages of 10 and 20 years.¹ As a result, isolated data on the management and outcome of pediatric skeletally immature patients who sustain such an injury pattern is limited.² In most studies on traumatic shoulder dislocation and recurrent instability, the pediatric population was only evaluated as part of a limited subgroup analysis in a larger study that included the adult population.³⁻⁸ Hence, a consensus has not emerged, as to what constitutes the appropriate mode of treatment or outcome for such an injury pattern in this particular patient population.

Most published data focus on the young, at-risk contact or collision sport athlete, for whom prophylactic surgical stabilization has proven to be an efficacious intervention subsequent to a trau-

matic dislocation. Therefore, proponents of surgical treatment are apt to extrapolate such data to the pediatric skeletally immature patient. Such reasoning, however, may be fraught with error, given that the dislocated pediatric shoulder in the presence of an open physis represents its own pathoanatomical entity.

Past studies have supported an alarming risk of recurrent shoulder instability in the pediatric patient who incurs a traumatic dislocation.^{4,9-11} As early as 1956, Rowe¹² demonstrated a 100% risk of recurrence if the patient sustained a primary dislocation before the age of 10 years. Another study by Marans et al¹³ also reported a 100% rate of redislocation in 21 adolescent patients with open physis who sustained a traumatic anterior dislocation. However, these 2 studies did not report on the functional outcome of these patients. Unfortunately, most of the studies in the literature have not isolated the skeletally immature group as the primary focus, nor

has any study utilized a validated functional measurement tool as a measure of ultimate patient outcome after a primary traumatic shoulder dislocation. The purpose of this study was to determine the intermediate-term outcome and rate of recurrent dislocation in skeletally immature pediatric patients who sustain a primary traumatic anterior shoulder dislocation by employing a validated quality-of-life measurement tool and documenting the complication as well as the rate of recurrent instability.

MATERIALS AND METHODS

This study was performed in accordance with the Institutional Review Board of our hospital. Between 1997 and 2004, 14 patients (14 shoulders) sustained a primary traumatic anterior shoulder dislocation during sports activity. Each patient was skeletally immature, with radiographic evidence of an open proximal humeral physis of the affected shoulder. Average patient age at the time of injury was 12.0 years (range, 10.9-13.1 years). Each patient underwent documented successful closed reduction of the affected shoulder with conscious sedation in the emergency room, and was subsequently treated with initial nonsurgical management. Specifically, all patients were treated with immobilization in a shoulder sling with instructions for nonweight bearing for 4 weeks from the date of injury. Thereafter, patients gradually advanced their shoulder motion with physical therapy as dictated by their comfort level.

All patients were subsequently monitored clinically, with routine office follow-up evaluation until each had reached skeletal maturity. On average, this occurred 3.4 years subsequent to the date of injury (Table 1). Clinical assessment emphasized objective evaluation of shoulder motion and stability. In addition, patients were questioned as to whether they had experienced a recurrent episode(s) of shoulder subluxation and/or dislocation. No patients had clinical evidence

TABLE 1					
Demographic Data of our Patient Population					
Patient #/ Sex/Age, y	Dislocation Side	Concomitant Greater Tuberosity Fracture	Duration of Follow-up, y	Imaging Method	Surgery ^a
1/F/11.2	L, nondominant	Yes	4	MRA	No
2/F/12.4	L, nondominant	Yes	2	MRA	No
3/F/11.6	R, dominant	No	4	MRA	No
4/F/12.8	L, nondominant	Yes	4	MRA	No
5/F/13.0	L, dominant	Yes	3	MRA	No
6/F/13.1	R, nondominant	Yes	4	MRA	No
7/F/12.3	L, nondominant	No	4	MRI	Yes
8/F/11.1	L, nondominant	No	4	MRA	No
9/F/11.9	L, nondominant	Yes	3	MRA	No
10/F/12.6	R, dominant	Yes	4	MRA	No
11/F/10.9	L, nondominant	No	4	MRA	No
12/F/10.1	L, nondominant	Yes	3.5	MRA	Yes
13/M/12.4	L, nondominant	No	2	MRA	Yes
14/M/12.1	L, nondominant	No	2	MRA	No

Abbreviations: L, left; MRA, magnetic resonance arthrogram; MRI, magnetic resonance imaging (noncontrast); R, right.
^aSurgery for recurrent dislocation of the affected shoulder.

of multidirectional instability of either shoulder. All patients also underwent either magnetic resonance imaging (MRI) or magnetic resonance arthrogram evaluation of the affected shoulder subsequent to the date of injury to further assess the integrity of the capsulolabral structures. Complications of the nonoperative treatment were also documented.

All patients were further evaluated with the Western Ontario Shoulder Instability index (WOSI). The WOSI, designed by Kirkley et al¹⁴, is a valid, reliable, responsive, and disease-specific quality-of-life measurement tool for patients with shoulder instability. The WOSI has 21 items and comprises 4 domains (physical symptoms, sports/recreation/work functions, lifestyle functions, and emotional functions). The best possible cumulative score is 0, which equates with no decrease in shoulder-related quality of life. Conversely, the worst possible total score is 2100, which signifies an extreme decrease in shoulder-related quality of life. The WOSI has been shown to be quite responsive to the effects of clinical intervention, more so than several other shoulder measurement tools.^{14,15} Such a tool is indicative of a patient's perception of treatment success or failure, and invaluable as a primary outcome measure. For each patient, WOSI scores were determined for the time of injury, as well as for the final follow-up. This effectively extended the average duration of postinjury follow-up to 5.6 years (range, 2-9 years).

RESULTS

Average patient age at the time of dislocation and for those who had recurrent instability that ultimately required surgery, was 11.6 years (range, 10-13 years). For the nonoperative treatment group, average age at the time of dislocation was 12.1 years. No significant difference in patient age was identified between the 2 groups ($P=0.61$). Of the 11 patients who were treated nonsurgically, average forward shoulder flexion was comparable to that

Patient #	Age at Dislocation, y ^a	Surgery	WOSI Scores		
			Baseline ^b	Final ^c	Δ^d
1	11.2	NO	1630	15	1615
2	12.4	NO	1690	20	1670
3	11.6	NO	1650	5	1645
4	12.8	NO	1630	20	1610
5	13.0	NO	1640	5	1635
6	13.1	NO	1630	10	1620
7	12.3	YES	1690	115	1575
8	11.1	NO	1620	0	1620
9	11.9	NO	1600	10	1590
10	12.6	NO	1610	15	1595
11	10.9	NO	1550	0	1550
12	10.1	YES	1690	195	1495
13	12.4	YES	1670	145	1525
14	12.1	NO	1590	0	1590
Average	12.0	-	1635	39.6	-
Nonoperative group	11.6	-	1683.3	151.7	1531.7
Operative group	12.1	-	1621.8	9.1	1612.7

^aNo significant difference in patient age between groups.
^bSignificant difference between baseline scores ($P=.0005$).
^cSignificant difference between final scores ($P=.02$).
^dSignificant difference between change in scores ($P=.05$).

of the contralateral, uninjured shoulder at final follow-up. On average, patients lost 11° of external shoulder rotation and 5° of internal rotation in comparison with the contralateral shoulder.

No patient had evidence of a discrete labral tear on MRI or magnetic resonance arthrogram evaluation of the injured shoulder; however, in the 3 patients that underwent surgery, a humeral avulsion of the glenohumeral ligaments was seen. Eight patients (57%) sustained concomitant non- or minimally displaced fractures of the ipsilateral greater tuberosity, all of which ultimately healed in an uneventful fashion. Three of the 14 patients (21%) sustained a recurrent dislocation of the affected shoulder, which ultimately ne-

cessitated surgical intervention (Table 1). These 3 patients underwent arthroscopic (n=2) and open (n=1) repair of the humeral avulsion of the glenohumeral ligament lesion of the injured shoulder, and their postoperative course was uneventful.

The average WOSI score for all patients at the time of injury was 1635 (range, 1550-1690). For those who ultimately required surgery (n=3; 21%), the WOSI score at the time of injury was 1683.3 (range, 1670-1690). In contrast, for those treated nonoperatively throughout the study duration, the average injury WOSI score was 1621.8 (range 1550-1690).

At final follow-up, the average WOSI score of all patients was 39.6 (range, 0-

195). The average final score of the patients in the nonoperative group (n=11) was 9.1 (range, 0-20), vs 151.7 (range, 115-195) for those managed surgically (n=3). The average change in score, from the time of injury to final follow-up, was greater in the nonoperative group than in the operative group (1612.7 vs 1531.7, respectively).

DISCUSSION

Presently, isolated outcome data are limited regarding primary traumatic anterior shoulder dislocation in the skeletally immature pediatric population. Therefore, a lack of consensus exists for the ideal treatment of such a patient. Although an abundance of data exists on dislocation in a mixed population of adolescent and young adult patients, caution should be taken in extrapolating such data to the pediatric skeletally immature patient.

Several studies report an alarmingly high rate of recurrent instability in pediatric-adolescent patients, with ranges from 33% to 100%.^{9,16-18} Wagner and Lyne¹⁶ described 9 pediatric patients (10 shoulders) that sustained traumatic shoulder dislocations. Eight of 10 shoulders (80%) developed recurrent instability that eventually required surgical stabilization. Hovelius et al⁹ presented a 10-year prospective study on primary shoulder dislocation in young patients. They cited a 38% dislocation recurrence rate in patients between the ages of 12 and 16 years. Postacchini et al¹⁷ retrospectively evaluated 28 patients between the ages of 12 and 17 years, each of whom had sustained a primary anterior shoulder dislocation, and reported an 86% rate of recurrence. However, when subdividing the age groups, patients whose age ranged 14 to 17 years had a 92% rate of recurrence vs patients younger than 13 years with open physis (rate of recurrence, 33%). This finding is also supported by Deitch et al¹⁸ who reported a recurrence rate of 53% in the skeletally immature group (open physis) vs 88% in the skeletally mature group (closed physis), which was statistically significant.

On the contrary, 2 studies reported a 100% rate of recurrent instability in skeletally immature patients.^{12,13}

In the current study, which comprises solely skeletally immature pediatric patients (age range, 10-13 years) who sustained traumatic anterior shoulder dislocation, the recurrence rate was 21.4% (3 of 14 patients). This lends credence to the idea that, regarding shoulder instability, children are not simply “little adults.” The primary pediatric traumatic shoulder dislocator represents a distinct pathoanatomical entity. It has been hypothesized that the capsular structures of the pediatric shoulder have a much greater elasticity than their adult counterparts.^{17,18} This finding, theoretically, would allow for a very resilient shoulder that is resistant to structural damage. Our findings support the above statement as no shoulder in this study incurred a discrete labral injury. However, in the 3 patients that underwent surgery, a humeral avulsion of the glenohumeral ligament lesion was seen with MRI. In addition, it is believed that a more laterally based capsular insertion on the glenoid in the pediatric skeletally immature patient would create a smaller anterior/inferior recess, as described by Rockwood and Matsen.¹⁹ This would impart increased tension on the anterior capsule when healed, making recurrent instability less likely in the younger pediatric population.¹⁸

Lawton et al² attempted to characterize pediatric shoulder instability with a retrospective review of 66 pediatric patients. Their study suggested that the characteristics of the unstable pediatric shoulder were associated with boys, adolescents, and trauma. However, in our study of patients between ages 10 and 13 years, 12 of 14 (86%) were girls. Also according to Lawton et al,² the surgically treated group was less likely to have recurrent instability or to report limitations when compared with the conservatively treated group. Although the mean age at the initial episode of shoulder instability in their study was

13.2 years (range, 4-16 years), the majority sustained their primary dislocation at greater than 14 years of age. Furthermore, they did not separate the patients based on skeletal immaturity, and they included patients that had subluxations as well as the dislocations. Hence, their study characterizes a heterogeneous mixture of adolescent patients, rather than pediatric patients with open physis. In addition, several types of surgery were performed by several surgeons in their study. As a result, it is difficult to compare the efficacy of nonoperative vs operative intervention in the skeletally immature patient. However, several studies support the notion that among young patients with shoulder instability, those treated surgically fare better than those treated nonsurgically.^{17,20-24}

Deitch et al¹⁸ retrospectively assessed 32 patients, 11 to 18 years of age, each of whom experienced a traumatic anterior shoulder dislocation. Seventy-five percent of the patients developed recurrent instability, leading 16 patients to undergo surgical stabilization. Despite surgical intervention, recurrent instability occurred in 5 of these 16 patients (31%). In their study, functional outcome scores (Rowe and SANE) were similar for both surgical and nonsurgical patients. Our data in the skeletally immature patients demonstrated a difference in final functional scores, with the nonoperative group (WOSI, 9.1; range 0-20) faring much better than the operative group (WOSI, 151.7; range, 115-195). However, due to the small number of patients in the surgical category (n=3), statistical analysis was not performed. Furthermore, the change in score from the time of injury to final follow-up was also greater in the nonoperative group than in the surgery group (1612.7 vs 1531.7, respectively). This data implies a more enhanced recovery and better functional outcomes for pediatric patients (open physis) with anterior trauma shoulder dislocations who are treated nonoperatively vs operatively. This is also supported by Lampert et al²⁵ who reviewed 54 pediat-

ric patients less than 14 years of age with shoulder dislocations and concluded that the treatment of choice in this age group is reduction, radiographic confirmation of the reduction, immobilization, and clinical examination after a couple of weeks. They concluded that the recurrence rate is so low in the pediatric skeletally immature patient population that conservative management is recommended.²⁵ However, their study did not evaluate these patients' functional outcomes. Furthermore, the surgical procedures in the 3 patients in our study who developed recurrent instability (n=3) were arthroscopic (n=2) and open surgical repair (n=1) of the humeral avulsion of the glenohumeral ligament lesion. No patients in our study group had labral tears (Bankart lesion) per MRI or magnetic resonance arthrogram. This finding further supports the statement that there is a significant difference in the pathoanatomy and injury pattern between the pediatric patients with open growth plates and young adult patients that incur an anterior shoulder dislocation.

This study has several limitations. The major limitation is that this is a retrospective analysis, with no randomization or control group. Ideally, to adequately compare the functional outcomes of surgical intervention vs nonoperative care, patients would have to be prospectively randomized into 1 of 2 treatment groups. The number of patients in this study population was also small (N=14), especially in the surgical group (n=3), which limits the ability to perform statistical analysis on the outcome data. Also, this study has some inherent bias, given that the more severe injuries (as determined by WOSI score) ultimately underwent surgery, thus the final outcome score may have been biased as well.

Despite the above limitations, the major strength of this study is the homogeneity of our patient population being a series of pediatric patients between ages 10 and 13 years with open physis at the time of the initial primary anterior traumatic dislocation. This is also the first study to evaluate

functional outcome in this patient population with validated WOSI scores. We were also able to separate the group according to treatment and compare the nonoperative vs operative groups. Despite this small study sample, clear patterns have emerged that support nonoperative treatment as an efficacious intervention in skeletally immature patient who sustain a primary traumatic anterior shoulder dislocation. However, a future randomized prospective study should be performed to evaluate the functional outcomes of patients in this age group comparing prophylactic surgical stabilization vs nonoperative management with statistical analysis.

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