

# Recurrent Shoulder Instability in a Young, Active, Military Population and Its Professional Implications

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**Background:** Shoulder instability is a topic of significant interest within the sports medicine literature, particularly regarding recurrence rates and the ideal treatment indications and techniques. Little has been published specifically addressing the occupational implications of symptomatic recurrent shoulder instability.

**Hypothesis:** Previous arthroscopic repair will continue to be a significant predisposing factor for recurrent instability in a young, active population, and that recurrent instability may have a negative effect on college graduation and postgraduate occupational selection.

**Study Design:** Case series.

**Level of Evidence:** Level 4.

**Methods:** We conducted a retrospective review of approved medical waivers for surgical treatment of anterior shoulder dislocation or instability prior to matriculation at the US Military Academy or the US Naval Academy for the graduating classes of 2010 to 2013. Statistical analysis was performed to determine the incidence and risk factors for recurrence and to determine the impact on graduation rate and occupation selection.

**Results:** Fifty-nine patients were evaluated; 34% developed recurrent anterior instability. Patients with previous arthroscopic repair had a significantly higher incidence of recurrence (38%,  $P = 0.044$ ). Recurrent shoulder instability did not significantly affect graduation rates or self-selected occupation ( $P \geq 0.05$ ).

**Conclusion:** There is a significant rate of recurrent shoulder instability after primary surgical repair, particularly among young, active individuals. In addition, arthroscopic repair resulted in a significantly higher recurrence rate compared with open repair in our population. Surgical repair for shoulder instability should not necessarily preclude young individuals from pursuing (or being considered for) occupations that may place them at greater risk of recurrence.

**Clinical Relevance:** The risk of recurrent instability is greater than the rate typically described, which may suggest that some subpopulations are at greater risk than others. A unique data point regarding instability is the effect on occupation selection.

**Keywords:** shoulder instability; dislocation; military

Shoulder instability, resulting from acute traumatic dislocation or subluxation of the glenohumeral joint, is a topic of significant interest within the sports medicine literature. Historically, a high rate of recurrent instability has been reported in younger, more active populations.<sup>2,17,25,32,34,38</sup> Much has also been written on whether operative management

is superior to nonoperative management for these injuries in young and active populations,<sup>2,8,38</sup> particularly as arthroscopic techniques have evolved over the decades.

The literature has also evaluated these injuries from many angles: arthroscopic versus open stabilization, recurrence in collision versus noncollision athletes, the influence of sports

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participation on recurrence, predisposing risk factors, and the effect of postoperative treatment.<sup>5,6,10,11,14,19,27,28,32-34,36</sup> Military studies have also been conducted specifically addressing the incidence and characteristics of shoulder dislocation and instability.<sup>2,3,6,7,28,29,36,38</sup>

The purpose of this study was to examine patients who had surgical intervention for anterior shoulder instability prior to matriculation as students at the US Military Academy (USMA) or the US Naval Academy (USNA). Factors leading to recurrent postoperative instability were investigated among USMA cadets and USNA midshipmen, with the hypothesis that previous arthroscopic repair continues to be a significant predisposing factor for recurrent instability in a young, active population. Furthermore, the impact of recurrent instability on graduation and occupational selection was evaluated, with the hypothesis that these factors may be adversely affected.

## METHODS

At both military academies, each potential cadet or midshipman with a preexisting medical condition must be evaluated by a military physician and granted a waiver prior to matriculation. These waivers are to ensure that the enrolling student is deemed healthy and medically fit for active-duty service, despite his or her preexisting condition. A retrospective review of these waivers was conducted for the graduating classes of 2010 to 2013.

These waivers were screened for patients who met inclusion criteria, specifically, patients with surgical repair for anterior shoulder instability prior to matriculation. Excluded patients included those who had posterior or multidirectional shoulder instability and patients who had concomitant shoulder pathology other than instability (ie, superior labrum anterior-posterior tear or acromioclavicular joint conditions). Bone block procedures also resulted in exclusion. Prior to initiation of the study, approval was obtained from the institutional review boards at each study site.

All patients who met the inclusion criteria were identified. A retrospective review was conducted of medical records between August 2006 and April 2014 as patients participated in their required physical education courses, competitive sports, and military training activities. These requirements have been previously described in the literature<sup>24</sup> along with their known increased risk for shoulder instability.<sup>29</sup> All instances of recurrent instability were identified. A recurrent instability event was categorized as either an anterior dislocation or subluxation event, as described by Owens et al,<sup>30</sup> and determined by the patient's history, mechanism of injury, physical examination, and magnetic resonance imaging findings.

All patients received their medical care through a closed medical system while they were enrolled at their respective academy, meaning all injuries occurring at the USMA or the USNA were evaluated by the orthopaedic or sports medicine clinics. An orthopaedic surgeon at either Keller Army Hospital

or Naval Health Clinic Annapolis evaluated all instances of recurrent instability. Also, since all cadets and midshipmen are required to participate in athletics, these injuries are documented in multiple electronic databases used for surveillance. Because of this closed medical system and existing injury surveillance mechanisms, the ability to detect injuries during the follow-up period was excellent.

Each patient's record was also reviewed for the following additional information: age, sex, type of previous repair, type of sport played prior to matriculation, and type of sport played at the academy. The type of previous repair was classified as either open or arthroscopic, based on patient history and physical examination findings. As mentioned earlier, all USMA and USNA students are required to participate in a sport, either intercollegiate or intramural. The patient's sport prior to matriculation was classified as either contact or noncontact<sup>1</sup> (limited contact and noncontact sports were classified as noncontact), if specifically stated in the patient's record. If it was not stated, the sport was considered unknown. All intramural athletes were characterized as contact athletes, as the majority of the intramural sports were also full contact in nature (eg, full-contact football, rugby, wrestling, and submission grappling).

Graduation rates and occupation selection were also evaluated in our cohort. Certain military occupations impose stringent physical fitness requirements above and beyond the baseline requirements for all active-duty military members (eg, special operations, infantry, pilots). These services were considered high risk, while service occupations without additional physical fitness requirements were considered low risk (eg, submariner, supply, administrative personnel).

Statistical analysis was performed on the data collected. Categorical data were presented as counts with percentages, and groups were compared using Fisher exact tests. Continuous data were described using means with standard deviations, and groups were compared using the 2-sample *t* test. A *P* value  $\leq 0.05$  was considered statistically significant.

## RESULTS

Fifty-nine patients who met the inclusion criteria were identified (56 [95%] men and 3 [5%] women). The mean age was 19 years. Thirty-nine (66%) patients sustained their initial injury while playing a contact sport. Forty-seven patients (80%) had a previous arthroscopic repair, whereas 12 (20%) were repaired by open means. Fifty (85%) of 59 patients were enrolled in a contact sport while at the academy compared with 9 (15%) who were engaged in noncontact sports. Twenty (34%) patients had a recurrent instability event during their 4 years at the service academy (Table 1).

Univariate analysis showed that patients who had a previous arthroscopic repair had a significantly higher incidence of recurrence (38% vs 8%,  $P = 0.044$ ). Recurrent shoulder injury had no significant impact on graduation or selected military occupation (Table 2).

Table 1. Demographic variables

Characteristic	Patients (N = 59), n (%)
Age, y, mean ± SD	19.1 ± 1
Sex	
Male	56 (95)
Female	3 (5)
Type of sport played prior to matriculation	
Contact sport	39 (66)
Noncontact sport	8 (14)
Unknown	12 (20)
Type of initial surgical repair	
Arthroscopic	47 (80)
Open	12 (20)
Type of sport played at academy	
Contact sport	50 (85)
Noncontact sport	9 (15)
Level of sport played at academy	
Intercollegiate	44 (75)
Intramural	15 (25)
Incidence of recurrence (first recurrence)	
No recurrence	39 (66)
Recurrence	20 (34)

## DISCUSSION

Despite technical advances in the surgical treatment of shoulder instability, recurrent instability remains a significant risk, particularly in young, active patients. Previous studies have helped shed some light on the incidence and characteristics of shoulder dislocation and instability in a military population. The US military population had an overall incidence rate of 1.69 dislocations per 1000 person-years,<sup>28</sup> which is considerably higher than the reported rate in the civilian population.<sup>21,26,35,39</sup> Male sex, Caucasian race, and age less than 30 years were all independent risk factors. Of the 4141 cadets at West Point, 117 had a primary instability event and 11 had a recurrent event, with a 2.8% 1-year incidence proportion overall.<sup>29</sup> Shoulder subluxation represented 85% of instability events. In a study of 20 midshipmen at the Naval Academy, nonoperative treatment

was successful in 75% of patients when coupled with an appropriate rehabilitation protocol.<sup>3</sup> Patients who entered the USMA with a self-reported history of shoulder instability were 5.6 times more likely to experience a recurrent instability event during their 4 years at the academy when compared with those with no prior history of instability at the time of matriculation.<sup>9</sup> Regarding the studies involving West Point cadets, there is no delineation as to whether students had preexisting shoulder pathology prior to matriculation, what factors led to recurrent instability in this population, and the professional implications of recurrent shoulder instability.<sup>2,29,36,38</sup>

Open stabilization procedures have historically been associated with a lower rate of recurrence than arthroscopic procedures (range, 6.7%-10% vs 6%-40%, respectively<sup>13,15,16,22,31</sup>). However, recent prospective, randomized trials comparing open with arthroscopic techniques showed similar recurrence rates and overall increased postoperative shoulder range of motion in patients treated the arthroscopically. This is thought to be related to preservation of the subscapularis insertion with the arthroscopic technique.<sup>7,12</sup> As new implants, instrumentation, and surgeon comfort with arthroscopy have increased, arthroscopic techniques have gained popularity. In fact, 84% of shoulder stabilization procedures in the United States are performed arthroscopically.<sup>40</sup> This is consistent with the 80% of patients who were initially treated arthroscopically in this study. Of particular note in this study was the significantly higher rate of recurrence in patients who received arthroscopic (38%) compared with open (8%) labral repair. These findings are comparable to previous studies<sup>13,15,16,22,31</sup> and suggest that previous arthroscopic stabilization significantly increases the risk of recurrent instability in a young, physically active population.

Age is the most significant patient-related factor associated with recurrence of shoulder instability, with or without surgical repair. This may be due to the fact that the connective tissue strength of the capsulolabral complex and the glenoid increases with age or that younger patients are more likely to engage in activities that put their repair at risk, or both. Prior studies report a significantly increased recurrence rate in patients 20 years or younger (14%-37.5%) compared with patients older than 20 years (10%-15.7%).<sup>4,18,20,23,37</sup> The entire cadet and midshipman population presented here had their initial surgery well before their 21st birthday, and the overall recurrence rate of 34% is on the higher end of previously reported studies.

Sex is a significant patient-related factor for recurrent instability. Previous studies have shown that males tend to have higher recurrence rates than females. Porcellini et al<sup>32</sup> showed a recurrence rate of 10.1% in males and 2.8% in females. Unfortunately, with such a low number of females in the presented cohort, definitive conclusions based on sex cannot be drawn.

At military institutions, all students must be able to complete a physical fitness test to be eligible for commissioning into their respective military branch. Each service's physical fitness test consists of sit-ups or crunches, push-ups, and a run. If a student is unable to complete all 3 events with an acceptable score, the

Table 2. Univariate analysis of independent variables and recurrence of shoulder instability

Characteristic	Patients (N = 59), n	Recurrent Instability (N = 20), n (%)	No Recurrence (N = 39), n (%)	P Value
Age, y, mean ± SD		19 ± 0.9	19.1 ± 1.0	0.720 <sup>a</sup>
Sex				0.035 <sup>b</sup>
Male	56	17 (30)	39 (70)	
Female	3	3 (100)	0 (0)	
Initial mechanism of injury				0.548 <sup>b</sup>
Contact sport/event	39	13 (33)	26 (67)	
Noncontact sport/event	8	4 (50)	4 (50)	
Unknown	12	3 (25)	9 (75)	
Type of initial surgical repair				0.044 <sup>b</sup>
Open	12	1 (8)	11 (92)	
Arthroscopic	47	18 (38)	29 (62)	
Type of sport played at academy				0.109 <sup>b</sup>
Contact sport	50	14 (28)	36 (72)	
Noncontact sport	9	5 (56)	4 (44)	
Level of sport played at academy				0.011 <sup>b</sup>
Intercollegiate	44	10 (23)	34 (77)	
Intramural	15	9 (60)	6 (30)	
Graduation status				0.746 <sup>b</sup>
Graduated	46	15 (33)	31 (67)	
Did not graduate	13	5 (38)	8 (62)	
Selected occupation (N = 46)				>0.99 <sup>b</sup>
High risk	36	12 (33)	24 (66)	
Low risk	10	3 (30)	7 (70)	

<sup>a</sup>Two-sample *t* test.<sup>b</sup>Fisher exact test.

student is separated from the military prior to graduation. Furthermore, each student has the opportunity to apply for his or her desired postgraduate occupation but must meet increased physical demands for certain occupations (eg, infantry, special operations, pilot). Recurrent instability did not significantly affect graduation rates or the occupation these students selected postgraduation. That is, despite recurrent instability requiring revision stabilization, many students still went on to graduate and qualify to participate in high-risk occupations. These data

are useful in that they aid orthopaedic surgeons in counseling patients who are considering engaging in high-risk occupations, whether military or a civilian equivalent position (eg, firefighter, police officer, emergency medical services). While they are certainly at greater risk of a recurrent instability event, acceptable postoperative shoulder function and peak physical performance are still attainable.

This study has several notable limitations, particularly with regard to the inherent limitations of retrospective studies. The

cohort size was limited by the data available; a larger cohort would allow for greater power and possibly greater significance between variables. Arthroscopic technique was associated with an increased rate of recurrent instability; however, there are many confounding factors that may explain this finding. For example, the surgical technique of each patient's initial or subsequent surgery, given the study design, was not standardized. Each patient's initial surgery was performed by different orthopaedic surgeons, each of whom likely had differing levels of training. Intraoperative factors, such as type and number of anchors used, were unknown. Also, postoperative factors were uncertain, such as the postoperative rehabilitation protocol used for each patient. Other contributing factors to instability were unaccounted for as well, such as varying degrees of ligamentous laxity and/or glenoid bone loss.

## CONCLUSION

Identifying risk factors for recurrent instability and continually improving surgical techniques are paramount in reducing the number of these events in the future and for allowing appropriate preoperative patient education and informed consent. A significant rate of recurrence of shoulder instability can exist after primary surgical repair, particularly among young, active individuals (34% in this study). Arthroscopic repair resulted in a significantly higher recurrence rate compared with open repair, while considering the notable aforementioned limitations.

However, while 34% overall recurrence is an impressive number, this does not necessarily translate to functional limitations, as evidenced by the lack of impact on graduation rate and entry into active military service and high-risk occupations. The present data support the notion that peak physical performance, even in high-risk occupations, is attainable, which can be translated into civilian-equivalent occupations as well. Therefore, prior surgical repair for shoulder instability should not necessarily preclude young, active individuals from pursuing (or being considered for) occupations that may place them at greater risk of recurrence.

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