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SHOULDER



# Sex-related differences in patients undergoing surgery for shoulder instability: a Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability cohort study

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**Hypothesis and background:** Male sex has been identified as a risk factor for both primary shoulder dislocation and recurrent instability, and male patients more often undergo surgery for instability. Despite published discrepancies between sexes regarding the incidence and surgical rates of shoulder instability, there is little detail on the differences in presentation, mechanism of injury, and intraoperative findings. The purpose of this study was to explore these differences.

**Methods:** Prospective baseline data from 1010 patients in the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability cohort were analyzed for sex-related differences using demographic characteristics, patient-reported outcomes, radiographic findings, intraoperative findings, and surgical procedures performed. Two-tailed *t* tests and  $\chi^2$  tests were used to compare the continuous

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and categorical data, respectively. Patients were categorized using the Frequency, Etiology, Direction, Severity (FEDS) classification system.

**Results:** Male patients comprised 81.3% of the cohort. Male patients had a significantly higher rate of traumatic instability and rate of initial instability while playing sports, as well as significantly higher activity scores. Female patients had significantly lower preoperative American Shoulder and Elbow Surgeons, Western Ontario Shoulder Instability Index, 36-Item Health Survey, and Single Assessment Numeric Evaluation scores. No difference in the number of dislocations was found between male and female patients. Intraoperatively, male patients had higher rates of labral pathology and bone loss whereas female patients had higher rates of capsular laxity. These differences resulted in more Latarjet procedures for male patients and more soft-tissue procedures for female patients.

**Conclusion:** There are differences between male and female patients in the etiology of their instability, baseline patient-reported outcomes, and associated shoulder pathology, likely reflecting intrinsic and activity-related variation. These differences may influence clinical decision making and patient outcomes.

**Level of evidence:** Level II; Prospective Cohort Design; Treatment Study

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Sex-based differences have been described across virtually all aspects of health and medicine. A 2001 Institute of Medicine report recommended that sex should be considered a factor in all biomedical research.<sup>26</sup> Among the findings summarized were the concepts that sex differences lead to both natural variations and differences in perceptions of health. These variations, along with environmental factors, lead to many significant differences, such as a higher incidence of cholelithiasis, higher prevalence of Alzheimer disease, and greater frequency of cardiovascular death in female individuals.<sup>15,16,25</sup> Hormonal differences further contribute to metabolic differences including well-known effects of estrogen on bone mass but also on obesity and body weight regulation.<sup>5,20</sup>

The existence of epidemiologic and prognostic differences in male and female orthopedic patients has also been well described, with variation attributed to a combination of anatomy, hormones, and genetics.<sup>28</sup> For example, epidemiologic differences are seen in adhesive capsulitis and hip fractures, which are both more common in female patients, but male patients have a significantly higher mortality rate after hip fracture than female patients.<sup>1,4,9</sup> Sex-related differences have been described in anterior cruciate ligament (ACL) injuries. Varying rates of additional intra-articular pathology associated with ACL injuries have been demonstrated via sex-based analysis, with evidence supporting the contribution of intrinsic joint differences between male and female patients.<sup>3,18</sup> Furthermore, higher rates of ACL tears have consistently been reported in female patients, ranging from 2 to 6 times higher than those in their male counterparts depending on the sport, with injuries also associated with specific menstrual-cycle hormone levels.<sup>22,27</sup> Studying differences between sexes often elicits results demonstrating that patients with a similar diagnosis do not represent a homogeneous

group. This, in turn, provides context and association between etiology, pathology, and ultimately, intervention, allowing surgeons to provide evidence-driven treatments and prognoses to patients.

There are few data regarding specific sex-related differences in patients undergoing surgery for shoulder instability. Carter et al<sup>7</sup> summarized currently known sex-related differences in shoulder instability, noting that anatomic studies have indicated the female glenohumeral joint to be at greater potential risk of instability owing to morphologic differences, specifically a more oval shape. In contrast, Owens et al<sup>17</sup> identified male sex as a risk factor for shoulder dislocation in a high-risk population. Although male patients have been shown to constitute approximately 80% of patients undergoing surgery for shoulder instability, female patients still account for a significant number of surgical procedures owing to the high frequency of instability in the population.<sup>11</sup> The high rate of injury in active patients demonstrates the need for further understanding of sex-related differences in shoulder instability.

The purpose of this study was to investigate differences between male and female patients undergoing surgery for shoulder instability using demographic data, patient-reported outcomes (PROs), radiologic findings, and operative data from the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability cohort.

## Methods

### Study design

The MOON Shoulder Instability study is an institutional review board–approved, multicenter prospective cohort of patients undergoing operative treatment for shoulder instability. The

epidemiology of the cohort has previously been described by Kraeutler et al.<sup>11</sup> Patients were prospectively enrolled by 26 sports medicine or shoulder fellowship-trained surgeons in 9 private and academic groups across the United States. Baseline demographic characteristics, PRO scores, physical examination data, and preoperative imaging were collected. Operative findings and procedures performed were recorded by MOON surgeons after surgery. Data were recorded using Teleform (OpenText, Waterloo, ON, Canada) or REDCap (REDCap, Nashville, TN, USA).<sup>8</sup>

## Participants

Patients included for analysis were aged between 12 and 66 years, received a diagnosis of glenohumeral instability based on history and physical examination, and underwent primary or revision arthroscopic or open shoulder stabilization surgery. The exclusion criteria included concomitant rotator cuff tears necessitating repair, proximal humeral fractures (not including Hill-Sachs lesions), inability to provide informed consent, and workers' compensation claims.

## Data collection

Demographic data, medical comorbidities, surgical history, PROs, and history of the shoulder injury including sports involvement were collected. PROs included the American Shoulder and Elbow Surgeons (ASES) score, Western Ontario Shoulder Instability Index (WOSI), 36-Item Health Survey (RAND-36), and Single Assessment Numeric Evaluation (SANE). The shoulder activity score and Beighton hypermobility score were also assessed. Instability was categorized using the Frequency, Etiology, Direction, and Severity (FEDS) system.<sup>12</sup>

Radiographs were obtained and reviewed at the time of enrollment, and findings were recorded. True anteroposterior (Grashey), axillary, and Stryker notch views were obtained as part of the cohort protocol. Magnetic resonance imaging (MRI) and computed tomography (CT) findings were reviewed and recorded if obtained at the discretion of the treating surgeon. Findings of all imaging modalities were documented by the enrolling surgeon. Analysis of bone loss was based on both preoperative imaging and intraoperative visualization.

Intraoperative findings and surgical procedures were documented by each surgeon postoperatively. The presence and severity of anterior, posterior, and inferior capsule pathology were independently recorded on a spectrum as "normal," "laxity," or "tear." The anterior, posterior, and inferior labra were evaluated independently as "normal," "frayed," "cracked," "detached," or "recessed" (anterior labroligamentous periosteal sleeve avulsion). Labral findings were grouped for analysis as "frayed or cracked" and "detached or recessed" to represent lower- and higher-grade labral pathology.

## Statistical analysis

Patient data were analyzed to investigate all sex-related differences in demographic characteristics, shoulder injury history, PRO scores, radiologic findings, and associated intraoperative pathology. Continuous variables were reported as means and standard deviations and compared using 2-tailed *t* tests. Categorical variables were reported as counts and frequencies and compared using  $\chi^2$  tests.

## Results

### Demographic characteristics and history

There were 1010 patients, 821 of whom were male patients (81.3%). The average age was  $23.9 \pm 8.3$  years for male patients and  $25.2 \pm 10.4$  years for female patients ( $P = .109$ ). Previous shoulder surgical procedures were more common for male patients (21.5% vs. 14.8%,  $P = .039$ ) and more male patients experienced injuries during sports (75.5% vs. 63.3%,  $P = .001$ ), whereas a greater percentage of female patients reported that their shoulder had been bothering them for more than a year (57.7% vs. 49.0%,  $P = .033$ ). Female patients reported higher use of nonoperative therapy prior to surgery, including nonsteroidal anti-inflammatory drug use within the month before surgery (84.1% vs. 71.8%,  $P < .001$ ) and physical therapy within the 12 months before surgery (57.6% vs. 43.3%,  $P < .001$ ). Female patients also reported higher rates of both comorbid back pain (21.4% vs. 14.5%,  $P = .019$ ) and depression (17.0% vs. 9.2%,  $P = .002$ ). Female patients had higher mean Beighton hypermobility scores (2.76 vs. 0.65,  $P < .001$ ) and represented a much higher percentage of patients with scores of at least 5 (26.2% vs. 3.8%,  $P < .001$ ). Demographic characteristics are summarized in [Table I](#).

### FEDS classification

[Fig. 1](#) displays all possible combinations of the patient-reported FEDS system, as described by Kuhn,<sup>12</sup> stratified by sex. "FEDS" corresponds to "frequency" (solitary [S], occasional [O], or frequent [F]), "etiology" (atraumatic [A] or traumatic [T]), "direction" (anterior [A], posterior [P], or inferior [I]), and "severity" (subluxation [S] or dislocation [D]). Categories consisting of at least 5% of patients were OTAD (16.3%), STAS (12.8%), FTAD (11.6%), STAD (10.6%), OTAS (9.4%), FTAS (7.2%), and STPS (8.6%) for male patients and STAS (16.3%), OTAD (12.1%), STAD (11.4%), OTAS (9.2%), FTAS (7.6%), and FTAD (5.4%) for female patients. Etiology showed the only significant difference between the sexes; traumatic injury represented the majority for each sex, although male patients experienced a higher overall rate (84.1% vs. 77.3%,  $P = .030$ ). The frequency of instability episodes was similar between male and female patients, with over half of all patients experiencing at least 2 episodes. The primary direction was also similar, with approximately three-quarters of all patients describing anterior instability, regardless of sex ([Table I](#)). Severity was comparable, with 44.7% of male patients and 41.3% of female patients having dislocations.

### Patient-reported outcomes

Preoperative PROs were consistently lower in female patients, as shown in [Table II](#). The ASES, WOSI, SANE, and

**Table I** Demographic characteristics

	Male patients	Female patients	<i>P</i> value
Age, mean ± SD, yr	23.9 ± 8.3	25.2 ± 10.4	.109*
BMI, mean ± SD	25.9 ± 4.3	24.8 ± 4.8	.001*
Smoking	51 (6.2)	7 (3.7)	.322†
Beighton score, mean ± SD	0.65 ± 1.5	2.76 ± 2.9	<.001*
Beighton score ≥ 5	29 (3.8)	45 (26.2)	<.001†
Education			.002†
No high school	7 (0.9)	6 (3.2)	
Some high school	234 (28.5)	49 (25.9)	
Completed high school	84 (10.2)	12 (6.3)	
Some college	195 (23.8)	37 (19.8)	
Associate degree	21 (2.6)	7 (3.7)	
Bachelor's degree	188 (22.9)	39 (20.6)	
Graduate degree	91 (11.1)	38 (20.1)	
Frequency			.553
Solitary (1 episode)	330 (40.4)	81 (42.9)	
Occasional (2-5 episodes)	278 (34.0)	64 (33.9)	
Frequent (>5 episodes)	209 (25.6)	44 (25.6)	
Traumatic injury	684 (84.1)	143 (77.3)	.026†
Injured during sports	616 (75.5)	117 (63.6)	.001†
Primary direction of instability			.727†
Anterior	626 (76.3)	145 (76.7)	
Posterior	194 (23.6)	42 (22.2)	
Severity			.684
Subluxation	452 (53.3)	110 (58.5)	
Dislocation	366 (44.7)	78 (41.5)	

SD, standard deviation; BMI, body mass index.

Data are reported as reported as frequency (percentage) unless otherwise indicated.

\* Two-sided *t* test.

† Pearson  $\chi^2$  test.

RAND-36 physical component scores showed lower baseline function at the time of surgery in female patients ( $P < .001$ ). Female patients had a higher perceived level of preoperative shoulder pain on the visual analog scale for pain ( $P < .001$ ), whereas male patients reported a higher activity level on the shoulder activity scale ( $P < .001$ ). Although each PRO showed a significant difference, only the difference in the ASES score was greater than the reported minimal clinically important difference (MCID) of 6.4.<sup>14</sup> The differences fell below the MCID for the WOSI score (10.5) and SANE score (15.0).<sup>10,24</sup> The MCID for the visual analog scale for pain has not been evaluated for shoulder instability but has been reported as 1.4 for rotator cuff disease, greater than the statistically significant difference of 1.1 shown in our study.<sup>23</sup> The MCID for the RAND-36 score has not been determined for shoulder conditions, although a 5-point difference has been reported as a general minimal detectable change.<sup>6</sup>

### Radiologic findings

Radiographs, MRI scans, and CT scans were obtained for 93%, 93%, and 12% of all patients, respectively. Radiographs and MRI scans were obtained for male and female

patients at similar rates, whereas CT scans were obtained significantly more often for male patients (14% vs. 6%,  $P = .005$ ).

Male patients were more likely to show radiographic evidence of bony glenoid defects ( $P = .021$ ), whereas rates of humeral defects were similar ( $P = .107$ ). However, 3-dimensional imaging showed higher rates of both Hill-Sachs lesions ( $P = .035$ ) and anterior glenoid defects ( $P < .001$ ) in male patients, which was consistent with surgeon-reported intraoperative findings. No difference in rates of posterior glenoid defects and reverse Hill-Sachs lesions was noted. MRI showed similar rates of anterior labral tears regardless of sex but higher rates of posterior tears and concomitant superior labrum from anterior to posterior (SLAP) tears in male patients. All analyzed radiologic findings are displayed in [Table III](#).

### Intraoperative findings

Male and female patients were found to have different rates of intraoperative pathology documented by the treating surgeon. Male patients more often experienced higher-grade injuries to the anterior, posterior, and inferior labrum defined as detached or recessed. Female patients more often

Solitary Traumatic Anterior Subluxation	Solitary Traumatic Anterior Dislocation	Solitary Traumatic Inferior Subluxation	Solitary Traumatic Inferior Dislocation	Solitary Traumatic Posterior Subluxation	Solitary Traumatic Posterior Dislocation
12.8	10.6	0	0	8.6	0.7
16.3	11.4	0.5	0	4.9	0.5
Solitary Atraumatic Anterior Subluxation	Solitary Atraumatic Anterior Dislocation	Solitary Atraumatic Inferior Subluxation	Solitary Atraumatic Inferior Dislocation	Solitary Atraumatic Posterior Subluxation	Solitary Atraumatic Posterior Dislocation
2.7	0.4	0	0	4.1	0.2
3.8	1.6	0	0	3.8	0.5
Occasional Traumatic Anterior Subluxation	Occasional Traumatic Anterior Dislocation	Occasional Traumatic Inferior Subluxation	Occasional Traumatic Inferior Dislocation	Occasional Traumatic Posterior Subluxation	Occasional Traumatic Posterior Dislocation
9.4	16.3	0	0.1	3.2	0.7
9.2	12.0	0	0	1.1	2.2
Occasional Atraumatic Anterior Subluxation	Occasional Atraumatic Anterior Dislocation	Occasional Atraumatic Inferior Subluxation	Occasional Atraumatic Inferior Dislocation	Occasional Atraumatic Posterior Subluxation	Occasional Atraumatic Posterior Dislocation
1.5	1.6	0	0	1.1	0.2
2.7	2.7	0	0	2.2	0.5
Frequent Traumatic Anterior Subluxation	Frequent Traumatic Anterior Dislocation	Frequent Traumatic Inferior Subluxation	Frequent Traumatic Inferior Dislocation	Frequent Traumatic Posterior Subluxation	Frequent Traumatic Posterior Dislocation
7.2	11.1	0	0	2.3	0.9
7.6	5.4	0.5	0	3.8	1.6
Frequent Atraumatic Anterior Subluxation	Frequent Atraumatic Anterior Dislocation	Frequent Atraumatic Inferior Subluxation	Frequent Atraumatic Inferior Dislocation	Frequent Atraumatic Posterior Subluxation	Frequent Atraumatic Posterior Dislocation
1.2	1.5	0	0	1.0	0.4
1.1	2.2	0	0	1.1	0.5

**Figure 1** Frequency, Etiology, Direction, Severity (FEDS) categories stratified by sex. The data are reported as percentage of all male patients (*dark blue*) and all female patients (*pink*); boxes shaded *light blue* represent categories with 5% of male or female patients, and those shaded *gray* represent categories with fewer than 1% of both.

experienced lower-grade injuries defined as frayed or cracked. Male patients had higher rates of bony Bankart lesions (23.1 vs. 14.0,  $P = .014$ ) and Hill-Sachs lesions (57.3% vs. 42.7%,  $P < .001$ ), whereas female patients had increased anterior (39.2% vs. 25.9%,  $P < .001$ ), posterior (19.0% vs. 9.0%,  $P < .001$ ), and inferior (31.7% vs. 16.2%,  $P < .001$ ) capsular laxity. Rates of capsular tears were similar regardless of sex. Male patients had higher rates of SLAP tears (27.5% vs. 19.0%,  $P = .028$ ). Full results are summarized in [Table IV](#).

## Surgical procedures

[Table V](#) summarizes procedures undergone by at least 5% of male or female patients. The postoperative form allowed for selection of multiple options, with an average of 1.6 and 1.5 procedures documented for male and female patients, respectively. The most common procedure overall, with similar rates regardless of sex, was “arthroscopic anterior Bankart—labrum and capsule” (55.8% for male patients vs. 58.7% for female patients,  $P = .462$ ). Female patients

**Table II** Preoperative patient-reported outcomes

	Male patients	Female patients	<i>P</i> value*
ASES score	67.6 ± 20.0	56.9 ± 19.7	<.001
WOSI score	44.3 ± 19.6	35.9 ± 16.9	<.001
SANE score	47.3 ± 24.1	40.5 ± 22.2	<.001
RAND-36 physical component score	47.0 ± 8.0	43.5 ± 7.7	<.001
VAS score for pain	2.7 ± 2.3	3.8 ± 2.5	<.001
Shoulder activity score	13.4 ± 4.4	12.0 ± 4.8	<.001

ASES, American Shoulder and Elbow Surgeons; WOSI, Western Ontario Shoulder Instability Index; SANE, Single Assessment Numeric Evaluation; RAND-36, 36-Item Health Survey; VAS, visual analog scale.

Data are reported as mean ± standard deviation.

\* Two-sided *t* test.

were less commonly treated with isolated anterior labral repair (3.7% vs. 10.5%,  $P = .004$ ). Notably, female patients underwent more isolated capsular plication procedures (18.0% vs. 5.4%,  $P < .001$ ), and male patients underwent more Latarjet-Bristow procedures (9.7% vs. 3.2%,  $P = .004$ ) and more SLAP repairs (20.0% vs. 13.2%,  $P = .032$ ).

## Discussion

This study found that, in patients undergoing surgery for shoulder instability, differences exist between male and female patients regarding demographic characteristics, etiology, associated pathology, baseline PRO scores, and surgical procedures performed. Prior studies have shown differences in PROs for ACL and rotator cuff injuries between male and female patients both preoperatively and

postoperatively, with lower scores in female patients for both injuries.<sup>2,19</sup> Similarly to these sex-based analyses, our study demonstrated that female patients undergoing surgery for shoulder instability had lower preoperative PRO scores. Statistically significant differences were found for each PRO evaluating shoulder pain and function, although only the difference in ASES scores was greater than the published MCID. These lower scores could be reflective of the higher proportion of female patients reporting symptoms for greater than 1 year. Future work should seek to address whether inferior preoperative scores are associated with inferior surgical outcomes.

Female patients had a higher mean Beighton hypermobility score, consistent with previous studies identifying joint hypermobility as a primarily female trait.<sup>13</sup> In addition, 26.2% of female patients vs. only 3.8% of male patients were found to have a Beighton score of 5 or greater,

**Table III** Radiologic findings

	Male patients	Female patients	<i>P</i> value*
Radiograph			
Glenoid defect (bony Bankart lesion)	16.6	6.9	.021
Humeral defect	22.1	13.1	.107
MRI or CT			
Anterior glenoid defect	21.6	10.1	<.001
Posterior glenoid defect	1.5	1.1	.693
Anterior humeral defect (reverse Hill-Sachs)	3.4	1.7	.231
Posterior humeral defect (Hill-Sachs)	45.5	36.9	.035
MRI			
Anterior labral tear	68.1	63.0	.197
Posterior labral tear	31.9	22.5	.016
SLAP tear	18.2	9.8	.008
ALPSA	6.8	5.8	.627
Spinoglenoid cyst	0.5	1.2	.345
HAGL	2.5	2.3	.895
GLAD	3.4	2.9	.735

MRI, magnetic resonance imaging; CT, computed tomography; SLAP, superior labrum from anterior to posterior; ALPSA, anterior labroligamentous periosteal sleeve avulsion; HAGL, humeral avulsion of glenohumeral ligament; GLAD, glenolabral articular disruption.

Data are reported as percentage of all male patients and all female patients.

\* Pearson  $\chi^2$  test.

**Table IV** Intraoperative findings

	Male patients	Female patients	P value*
Anterior capsular laxity	25.9	39.2	<.001
Anterior capsule tear	6.0	6.9	.638
Posterior capsular laxity	9.0	19.0	<.001
Posterior capsule tear	1.2	2.1	.341
Inferior capsular laxity	16.2	31.7	<.001
Inferior capsule tear	1.2	2.1	.126
Anterior labrum			
Frayed or cracked	4.1	9.5	.003
Detached or recessed	70.8	56.6	<.001
Posterior labrum			
Frayed or cracked	15.2	14.8	.887
Detached or recessed	32.6	21.2	.002
Inferior labrum			
Frayed or cracked	15.3	21.7	.034
Detached or recessed	20.7	11.6	.004
SLAP tear	27.5	19.0	.028
Bony Bankart lesion	23.1	14.0	.014
Hill-Sachs lesion	57.3	42.7	<.001

SLAP, superior labrum from anterior to posterior.

Data are reported as percentage of all male patients and all female patients.

\* Pearson  $\chi^2$  test.

showing a considerable contribution of hypermobility to instability in female patients. We also found that fewer female patients had a traumatic event leading to their instability, suggesting the role of both intrinsic and activity differences regarding injury mechanism. Male patients had higher shoulder activity scores, were more likely to experience a traumatic event leading to instability, and were more likely to be injured during sports.

Male and female FEDS classifications of instability were similar in all areas except etiology. Male patients were more likely to experience traumatic injuries. The most common category for male patients was OTAD

(16.3%). The most common category for female patients was STAS (16.3%). Robinson et al<sup>21</sup> described the risks of recurrent instability developing after primary dislocation, demonstrating that female patients treated non-operatively had a lower risk of recurrent instability at all ages and that 86.7% of all recurrent instability developed within 2 years. Our study showed that male and female patients undergoing surgery experienced episodes of instability at similar frequencies prior to surgery. The higher severity of labral injury and higher rate of bone loss demonstrated by our study likely contribute to the increased predisposition for recurrence in male patients,

**Table V** Surgical procedures

	Male patients	Female patients	P value*
Arthroscopic anterior Bankart procedure			
Labrum only	10.5	3.7	.004
Labrum and capsule	55.8	58.7	.462
Arthroscopic posterior Bankart procedure			
Labrum only	9.3	6.9	.298
Labrum and capsule	26.3	24.3	.577
Arthroscopic SLAP repair	20.0	13.2	.032
Arthroscopic débridement	7.9	6.9	.630
Arthroscopic suture plication	5.4	18.0	<.001
Open Latarjet-Bristow procedure	9.7	3.2	.004
Open inferior capsular shift	6.3	5.3	.590

SLAP, superior labrum from anterior to posterior.

Data are reported as percentage of all male patients and all female patients.

\* Pearson  $\chi^2$  test.

as reported by Robinson et al. Notably, their study included nonoperative patients, whereas we only looked at patients undergoing surgery.

Anterior instability was the most common direction for both sexes in our cohort of patients receiving surgical treatment. Posterior instability was a less common finding but occurred at similar rates for both male and female patients. Within the FEDS classification scheme, inferior instability was noted in fewer than 1% of all patients; however, inferior capsular laxity with or without inferior labral tears was noted as a surgical finding in 16.4% of female patients compared with 5.2% of male patients.

Male patients experienced higher rates of bone loss including Hill-Sachs and bony Bankart lesions. This can likely be attributed to the higher rates of traumatic injury in male patients. Similarly, male patients experienced a higher rate of labral injuries. Female patients, conversely, had higher rates of capsular laxity regardless of direction, which may contribute to the aforementioned higher rate of atraumatic instability in female patients. Consistent with these findings, male patients underwent more Latarjet-Bristow procedures, whereas more female patients required capsular plication. Concomitant SLAP tears were diagnosed and repaired more often in male patients. These differences in intraoperative pathology and surgical treatment likely reflect activity-level and biological differences between male and female patients, further demonstrating how activity and intrinsic sex-related differences contribute to clinical manifestations.

Limitations of the study include not including patients managed nonoperatively. We also included relatively few female patients overall ( $n = 189$ ) compared with male patients. There was an established protocol for radiographs, but 3-dimensional imaging modalities were obtained at the discretion of each surgeon. Strengths of our study include the large cohort size and enrollment of patients from a geographically diverse multicenter network of surgeons. Therefore, the findings likely represent a highly generalizable cohort.

## Conclusion

Male patients experience higher overall rates of shoulder instability, more often experience instability due to traumatic dislocations and sports participation, and have more bone loss and labral tears. Female patients have lower preoperative PRO scores, higher rates of capsular laxity and tears, and a protracted preoperative course.

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