High frequency of posterior and combined shoulder instability in young active patients

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Objective: The purpose of this study was to describe the epidemiology and demographics of surgically treated shoulder instability stratified by direction. We hypothesized that there would be an increased frequency of posterior and combined shoulder instability in our population compared with published literature. Secondarily, we assessed preoperative magnetic resonance imaging (MRI) reports to determine how accurately they detected the pathology addressed at surgery.

Materials and methods: A retrospective review was conducted at a single facility during a 46-month period. The study included all patients who underwent an operative intervention for shoulder instability. The instability in each case was characterized as isolated anterior, isolated posterior, or combined, according to pathologic findings confirmed at arthroscopy. The findings were retrospectively compared with official MRI reports to determine the accuracy of MRI in characterizing the clinically and operatively confirmed diagnosis.

Results: A consecutive series of 231 patients (221 men, 10 women) underwent stabilization for shoulder instability over 46 months. Patients were a mean age of 26.0 years. There were 132 patients (57.1\%) with isolated anterior instability, 56 (24.2\%) with isolated posterior instability, and 43 (18.6\%) with combined instability. Overall, MRI findings completely characterized the clinical diagnosis and arthroscopic pathology in 149 of 219 patients (68.0\%).

Conclusion: The rate of posterior and combined instability in an active population is more common than has been previously reported, making up more than 40\% of operatively treated instability, including a previously unreported incidence of 19\% for combined instabilities. In addition, MRI was often incomplete or inaccurate in detecting the pathology eventually treated at surgery.

Level of evidence: Level III, Diagnostic Study.

Keywords: Shoulder instability; posterior shoulder instability; combined shoulder instability

This study was approved by the Tripler Army Medical Center Institutional Review Board (Protocol No. 12R12). The investigators adhered to the policies for protection of human subjects as prescribed in 45 Code of Federal Regulation Part 46.

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Shoulder instability is a common cause of shoulder pain and dysfunction in younger adults, especially in athletes and active duty service members. Historically, isolated anterior instability has been reported at significantly higher rates than posterior or multidirectional instability. Traditionally, posterior instability has been reported to account for only 2% to 5% of instability cases. This assumption was recently challenged with the report of higher rates of posterior instability in a young active population. In addition, several authors have reported combined instabilities and the importance of making a complete diagnosis to optimize outcomes. The purpose of this study was to describe the epidemiology and demographics of surgically treated shoulder instability according to the direction of instability at an active military treatment facility. We sought to determine how often posterior and complex instabilities were treated compared with isolated anterior instability. Further, we evaluated the accuracy of the preoperative magnetic resonance imaging (MRI) read to accurately characterize the labral pathology treated at the time of surgery.

Materials and methods

The institutional surgical database was queried for all operative cases for the treatment of shoulder instability between August 2009 and May 2013. Operative reports were reviewed to confirm that an arthroscopic instability procedure was performed, and the direction and extent of the pathology was quantified. Inclusion criteria were all patients aged between 16 and 45 who underwent first-time operative treatment for shoulder instability. Exclusion criteria included patients outside the ages of 16 to 45, patients without a diagnosis of shoulder instability, patients undergoing revision surgery for shoulder instability, and patients who were referred from a different region or state.

After identification of eligible patients, all clinic notes and operative reports were reviewed to obtain demographic data (age, sex, occupation, etc), the chief complaint, and the direction of instability. All cases were reviewed to ensure that the clinical examination was consistent with the pathology treated at the time of surgery. Patients were categorized into anterior, posterior, or combined groups by a clinical diagnosis, which included a history and physical examination, consistent with the direction(s) of instability and arthroscopic findings and treatment that was confirmatory of the definitive diagnosis. The anterior group included patients in whom the anterior or anteroinferior shoulder labral complex was primarily stabilized. Posterior patients included those in whom the posterior or postero-inferior labral complex was primarily stabilized. All other patients (panlabral tears, multidirectional instability, anterior plus posterior instability, instability with extension of the labral pathology into the superior labrum) were grouped into the combined category.

All MRI reports were reviewed to compare the radiologic interpretation of the anterior and posterior labrum with intraoperative findings of a labral tear. At the study institution, shoulder MRIs are most frequently read by the musculoskeletal radiologist; however, general radiologists may read the study in the event the musculoskeletal radiologist is unavailable. No established protocol exists for the use of intra-articular gadolinium, but it is typically used when the study is ordered by an orthopedic provider. A standard protocol was used by the radiologists for reading the shoulder MRIs, which consistently noted the status of each part of the labrum. This MRI evaluation was compared with the surgeon’s final intraoperative diagnosis, because the surgeon had the benefit of being able to combine the history, physical examination, MRI, and arthroscopic visualization.

Statistical analysis

An a priori power analysis was performed using the exact binomial distribution to calculate the confidence interval (CI) around a proportion of the event (posterior instability) based on data from the literature. With the CI set at 95%, we calculated the number of cases required to obtain the expected proportion. Results showed that a sample size of 90 patients would provide sufficient sensitivity for testing frequency of posterior instability within 8% points with 95% confidence. The power analysis also validated that the sample size was readily sufficient to quantify differences in contrast with a frequency of between 2% and 10% from the literature for posterior instability, thus detecting any difference between 20% and 10% frequency based on exact binomial distribution for a 2-sided test. Analyses for describing a posterior significance of differences between posterior and anterior cohorts leveraged t-tests for proportions for categoric variables (eg, with vs without) and for means for continuous variables (eg, age). Contrasts for differences in interpretation rates or other key research questions were also conducted using t-tests for proportions and the Mann-Whitney U test (also known as the Mann-Whitney-Wilcoxon test).

Results

There were 231 primary, arthroscopic, glenohumeral stabilization procedures performed within the time period. There were 221 male and 10 female patients, with a mean age of 26.0 years (range, 16-44 years). When the groups were compared, there was a significant difference in mean age between the isolated anterior and posterior groups (25.4 vs 27.4 years, respectively; \( P = .018 \)). The average age of the combined group was 26.1 years and was not significantly different from the anterior or posterior group. There was no statistical difference among the groups with regards to sex (Table I).

Of the 231 patients who underwent operative fixation for shoulder instability, 132 (57.1%) were secondary to isolated anterior instability, 56 (24.2%) for isolated posterior instability, and 43 (18.6%) were classified as combined pathology (Table I). No statistical differences were found when the individual ratios of each surgeon were compared with each other or when each surgeon was compared with the whole (\( P > .12 \) for all comparisons).

Overall, an MRI was performed before the operation in 219 of 231 patients (94.8%). MRI findings, as read by the radiologist, correlated with arthroscopic findings in 149 of 219 patients (68.0%). Correlation between MRI findings and intraoperative findings differed among the groups. The
anterior group showed a correlation in 95 of 121 patients (78.5%), and the posterior group showed a correlation in 38 of 55 patients (69.1%). However, accuracy was significantly decreased in the combined group, with only 16 of 43 instances (37.2%) correlated ($P < .001$). When analyzed by whether the MRI was read by a fellowship-trained musculoskeletal radiologist or a general radiologist, a statistically higher correlation was found between imaging and operative findings for the collective findings (74.8% vs 58.6%, $P = .01$) and the posterior group (81.2% vs 52.2%, $P = .04$) but not the anterior or combined groups.

In addition, there was no difference overall between MRIs performed with and without gadolinium contrast (67.1% vs 71.2%, $P = .63$). When each group (anterior, posterior, and combined) was analyzed individually and broken down by who read the MRI, there were several significant findings. The anterior and combined pathologies were more accurately read by musculoskeletal radiologists without gadolinium (91.3% vs 80.0%, $P = .05$) than with gadolinium (66.7% vs 43.5%, $P = .04$). Conversely, general radiologists were more accurate on MRIs with gadolinium compared with those without in the anterior and combined pathologies, whereas they were more accurate without gadolinium in the posterior group.

### Discussion

We found that more than 40% of arthroscopic shoulder stabilization procedures performed at our institution were for posterior or combined instabilities. In addition, our frequency of combined instability has not been previously reported in the literature to our knowledge. At 18.6% of glenohumeral stabilization procedures, this represents a significant portion of patients in an instability population. Such a frequency highlights the importance of maintaining a high index of suspicion and operative preparation for the combined lesion.

Posterior shoulder instability is reported as a less common form of shoulder instability. Previous literature shows that posterior instability comprises approximately 2% to 5% of all shoulder instability. The prevalence of shoulder instability in general is often reported higher in military populations than in the general population. More recently, posterior instability was reported at an increased incidence of 10.3% in a prospective epidemiologic study at the United States Military Academy. Although this study was a true epidemiologic report on incidence, and thus not able to be directly compared with our study, it does establish that in addition to increased shoulder instability in a military population, the percentage of that instability being posterior is higher than previously thought. A more recent report of an operative shoulder instability registry in Norway also noted a posterior incidence of 10%. The methodology of that study was very similar to the present study and highlights that it may be that not just military populations experience posterior instability than more traditionally thought (Table II).

The increased frequency noted in the current study has several possible explanations. The first is the population studied. Any military population consists of largely young men whose everyday duties include activities that place stress on the shoulder, including pushups, pullups, and overhead lifting. These requirements place repetitive stress particularly on the static and dynamic shoulder stabilizers. Repetitive microtrauma, as sustained during these mandatory activities, contributes to the proposed mechanisms of the atraumatic etiology of posterior shoulder instability. Given that such activities are often a daily occupational necessity, these patients may have more difficulty modifying activities as a conservative treatment strategy. Thus, these patients may present for operative treatment more commonly than their civilian counterparts whose jobs do not require these activities. Combined labral pathology, such as panlabral lesions, have been proposed to result from extension of more confined labral pathology that is neglected over time and thus may be more commonly encountered in a military population.

That posterior and combined instability has traditionally underdiagnosed in contrast to the anterior counterpart is also a possibility. Patients with posterior instability commonly present without an acute traumatic injury and with a chief complaint of pain, which may lead entry-level practitioners away from a diagnosis of instability. Competitive athletes with posterior instability may also complain of decreased performance. The physical examination for posterior instability may also be subtler than that of anterior instability. The anterior apprehension test and relocation test is a simple provocative test for anterior instability with specificity reported at greater than 95%. Common provocative physical examination tests for
Posterior and combined shoulder instability include the Kim test, jerk test, and push-pull test. Although the combination of these tests have shown a specificity of 97% for the diagnosis of posterior instability, they are less likely to be routinely performed by primary care providers and even, perhaps, by less experienced orthopedic surgeons.

Finally, the radiographic evaluation of posterior and combined instability may also be subtler than its anterior counterpart. Posterior labral abnormalities are often less displaced, or partially torn, than the classic anterior Bankart or its variants. Previous studies have reported correlations of MRI or MRI arthrogram and arthroscopic findings with varying degrees of success. In a study by 2 musculoskeletal radiologists who retrospectively reviewed MRI arthograms in 121 patients with known surgical findings and diagnoses of anterior glenohumeral instability, sensitivity and specificity were both reported at 92%. Other studies have reported sensitivities between 91% and 100%.

The MRI findings in our study correlated with intraoperative findings in 78.5% for anterior instability, 69.1% in posterior instability, and 37.2% for combined instability. Overall, the musculoskeletal radiologist was more accurate in diagnosing shoulder instability. The use of gadolinium did not affect the overall accuracy in the diagnosis of shoulder instability.

We cannot definitively identify the explanation for the significant difference in age between patients with isolated anterior and posterior pathology. The report by Blomquist et al described a similar difference in ages between their anterior group and posterior group. Yet, a posterior instability cohort with an average age much younger than ours has also been reported. One potential explanation is that the delay in diagnosis of posterior or combined instability due to the above subtleties may contribute to this finding as well because of the cultural acceptance that anterior instability is accepted as an "operative case" and thus may be referred earlier for definitive stabilization. In addition, it is also possible that because the chief complaint is pain, patients may be able to neglect this symptom longer than they can a dislocation event.

Nevertheless, it is worth stating that in a busy, largely active duty population, only 57% of patients with instability were purely anterior and 24% were posterior. To our knowledge, this series represents the highest comparative percentage of posterior and combined instability in the literature in addition to the lowest percentage of isolated anterior instability. Further, to our knowledge, this is the first report of the frequency of combined instability in an operative cohort. Thus, surgeons whose practices include a large population of young, aggressive patients may benefit from a heightened awareness and standardized assessment that specifically tests for posterior as well as combined instability signs and symptoms in all patients with suspected instability.

This study has several weaknesses. First, it represents a relatively short interval of less than 4 years. A longer collection period could possibly change the distribution. It is of note, however, that the 3 fellowship-trained sports surgeons saw only 57.1% purely anterior instability and that the individual ratios were similar for anterior, posterior, and combined instability among the surgeons.

Another weakness is the retrospective nature of this study, which introduces a potential selection bias. This is, however, partially offset by the fact that it is a consecutive case series and that no procedures were omitted that met inclusion criteria. In addition, we only evaluated operative cases. The numbers might possibly change if all nonoperative instances of shoulder instability were evaluated.

However, we believe that one of the stronger points of this study is that it increases the level of awareness for the increased rate of posterior and complex instability for the surgeon who would use this information in his or her operative practice. The consequences of an incomplete diagnosis are potentially at a higher cost than in patients treated conservatively.

Another limitation of the study is the predominately male military patient cohort that may not be generalizable to a population where the patients are not male and not regularly physically active. Finally, no validated outcome measures are reported, and therefore, we cannot comment on the relative effectiveness of treatment.

**Conclusion**

Cases of posterior and combined instability represent a significant percentage of patients who undergo operative treatment for shoulder instability. Surgeons who treat instability should maintain a high index of suspicion for these diagnoses and should perform a standardized and complete workup to ensure that all aspects of instability are characterized. An over-reliance on the MRI read may lead to an incomplete or inaccurate diagnosis, and MRI should be used only as an adjunctive tool to a comprehensive history, physical examination, and meticulous diagnostic arthroscopy.

**Disclaimer**

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**Supplementary data**

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