## *Posterior Instability in Adolescents: Clinical and Imaging Characteristics and Distinctions Compared to Anterior Instability*

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INTRODUCTION:

Shoulder instability is a complex problem, defined as anterior and/or posterior translation of the humeral head on the glenoid, resulting in subluxation or frank dislocation of the glenohumeral joint. As the prevalence of children and adolescents participating in contact sports continues to rise, so too does the incidence of posterior shoulder instability in this patient population.

While the incidence of associated pathologies and imaging abnormalities (such as the presence of posterior Humeral Avulsions of the Glenohumeral Ligament (HAGL) lesions, Anterior Hill-Sachs Deformities, reverse bony Bankart lesions, as well as posterior Glenoid Labrum Articular Disruption (GLAD) lesions) have been described in the adult population for posterior instability, the incidence and associations of these lesions in adolescent posterior instability remains unknown.

The purpose of the current study was to evaluate a consecutive series of patients treated surgically for posterior instability, with a focus on magnetic resonance imaging (MRI) abnormalities, to identify their incidence and any associations that these abnormalities may have with patient demographic and injury variables. Furthermore, the posterior instability patients were compared to a consecutive cohort of adolescents undergoing surgery for anterior instability to investigate differences between these two cohorts.

METHODS:

This was a retrospective case series with two comparison cohorts, from two fellowship trained sports medicine surgeons at a tertiary pediatric care center. Cases of surgical anterior and posterior instability were queried from 2015-2019. Inclusion criteria specified patients who were under 21 years of age at time of undergoing surgery for posterior or anterior instability. Exclusion criteria included those with multidirectional instability, collagen disorders, history of previous ipsilateral shoulder surgery, and age greater than or equal to 21 years. Collected data included demographics, injury mechanism, symptomatology (pain, instability, or both), number of instability episodes, and imaging characteristics (skeletal maturity, labral pathology, glenoid morphology, glenoid or humeral bony pathology, and acromial pathology). This study was approved by the Hospital institutional review board (registration no. 192008).

Nearly all patients underwent MR arthrogram (MRA) of the shoulder prior to surgery. Pathology and glenohumeral morphology were evaluated by a fellowship-trained musculoskeletal radiologist and confirmed by the corresponding orthopaedic surgeon (ATP). Skeletal maturity was determined on MRI and deemed mature or immature based on closure of the proximal humeral physis. Glenoid version was measured using the Friedman method. Acromial tilt was measured as defined by Meyer et al.

The purpose of this study was to provide descriptive characteristics of these two distinct patient cohorts. These were compared, when appropriate, with the use of the unpaired t-test. Continuous variables were reported as mean ± standard deviation (SD). Categorical variables were reported as the number from the total sample and as a percentage of the total. Comparison was conducted using chi-square test. Significance was set at $p<0.05$.

RESULTS:

A total of 72 patients were included (36 consecutive posterior and 36 matched anterior). Demographics of these cohorts are reported in **Table 1**. The posterior instability cohort complained of isolated pain in 47% (n=17) of cases and instability with pain in the remaining 53% (n=19) of cases, compared to 100% (n=36) reporting pain in the anterior group ($p<0.001$). Furthermore, the posterior instability group cited a traumatic event in 72% of cases (n=26) – significantly less than the anterior instability group (100%, n=36, $p<0.01$). Instability episodes were also less frequent in this group, on average (3.2 events for posterior vs. 5 events for anterior, $p=0.03$).

Significant differences between anterior and posterior shoulder instability were demonstrated on advanced imaging analysis, as depicted in **Table 2**. In particular, the posterior instability cohort had reverse Bony Bankarts in 11% (n=4), compared to 33% (n=12) in the anterior group (p=0.023). Glenoid less bone loss was found in 14% (n=5) of the posterior cohort (anterior bone loss 44%, n=16, p>0.01). Reverse Hill Sachs lesions were found in 22% (n=8), significantly less than 94% (n=34) Hill Sachs lesions in the anterior group (p<0.01). Glenoid retroversion averaged 11° (±5) in the posterior instability cohort, 6° greater than the anterior cohort (p<0.01). Acromial tilt was also greater in the posterior cohort, averaging 68° (±11) (p<0.01). Humeral head translation was found in the posterior cohort in 42% (n=15) of patients, greater than the anterior cohort (19%, n=7, p<0.48).

DISCUSSION AND CONCLUSION:

Posterior instability carries a much more insidious symptomatic profile, with 50% less instability symptoms compared with the anterior instability cohort. Further, posterior instability may be associated with underlying radiographic risk factors (i.e.

glenoid retroversion, humeral head translation). There were also fewer reverse Hill Sachs and reverse bony Bankart lesions in the posterior instability group.

| | Total | Anterior | Posterior | |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | p |
| *Cases* | 72 | 36 (50) | 36 (50) | |
| *Age* | 16.0 (±1.3) | 15.8 (±1.3) | 16.1 (±1.3) | 0.16 |
| *Male* | 58 (81) | 29 (81) | 29 (81) | 0.76 |
| *Left sided* | 29 (40) | 11 (31) | 18 (50) | 0.09 |
| *Bilateral symptoms* | 9 (13) | 5 (14) | 4 (11) | 0.72 |
| *Traumatic mechanism* | 62 (86) | 36 (100) | 26 (72) | **<0.01** |
| *Instability symptoms* | 53 (74) | 36 (100) | 19 (53) | **<0.01** |
| *Instability episodes* | 4.0 (±4.0) | 5.0 (±3.6) | 3.2 (± 4.3) | **0.032** |

**Table 1:** Key demographics and statistical differences between cohorts

| | Total | Anterior | Posterior | |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | p |
| *Skeletally immature* | 18 (25) | 7 (19) | 11 (31) | 0.28 |
| *Labral tear** | 71 (99) | 35 (97) | 36 (100) | 0.76 |
| *HAGL** | 3 (4) | 1 (3) | 2 (6) | 0.59 |
| *Capacious capsule* | 40 (56) | 21 (58) | 19 (53) | 0.64 |
| *GLAD** | 11 (15) | 6 (17) | 5 (14) | 0.72 |
| *Bony Bankart** | 16 (22) | 12 (33) | 4 (11) | **0.023** |
| *Bone loss** | 21 (29) | 16 (44) | 5 (14) | **<0.01** |
| *Amount bone loss (%)* | 11 (±6) | 10 (±6) | 13 (±5) | 0.57 |
| *Hill Sachs lesion** | 41 (57) | 34 (94) | 8 (22) | **<0.01** |
| *Hill Sachs size (mm)* | 11 (±4) | 12 (±4) | 10 (±4) | 0.08 |
| *Glenoid retroversion (°)* | 8 (±5) | 5 (±3) | 11 (±5) | **<0.01** |
| *Humeral head translation** | 22 (31) | 7 (19) | 15 (42) | **0.048** |
| *% translation* | 32 (±11) | 29 (±10) | 33 (±12) | 0.21 |
| *Acromial tilt (°)* | 62 (±12) | 56 (±9) | 68 (±11) | **<0.01** |
| *Presence of loose body* | 5 (7) | 3 (8) | 2 (6) | 0.72 |

**Table 2:** Imaging related characteristics and statistical analysis between cohorts.
*reported as posterior bone loss or defect for the posterior cohort, and anterior bone loss or defect in the anterior cohort