

Influence of Chronicity, Number, and Type of Anterior Shoulder Instability Events on Hill-Sachs Lesion Size: A Morphometric Analysis of 255 Patients

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INTRODUCTION: Anterior shoulder instability is a common orthopedic condition that often results in osseous defects to the anterior glenoid and posterolateral humeral head, termed bony Bankart lesions and Hill-Sachs lesions (HSL) respectively. The introduction of the glenoid track concept has garnered significant attention towards understanding the role of glenoid bone loss in particular (1,2), with limited understanding of the role and management of humeral bone defects. Available literature has demonstrated that larger HSL size is an important predictor of recurrent anterior shoulder instability after arthroscopic Bankart repair (ABR) and may necessitate augmentation procedures such as remplissage to reduce rates of recurrent instability (3,4). However, it remains unclear what pre-operative factors influence HSL size at time of imaging. Therefore, the purpose of this study was to evaluate factors associated with HSL size at time of imaging, including the chronicity (acute versus chronic), number (one versus multiple), and type (subluxation versus dislocation) of prior anterior shoulder instability events. The hypothesis was that chronic instability, multiple prior instability events, and experiencing glenohumeral dislocation versus subluxation would result in larger HSL size.

METHODS: A retrospective review was conducted on all patients undergoing arthroscopic Bankart repair (ABR) with or without remplissage for anterior shoulder instability between 2007-2023. Exclusion criteria included age <14 years, revision surgery, glenoid bone loss >20%, unknown date of instability, missing or unavailable magnetic resonance imaging (MRI), and lack of HSL. Patients were characterized based on chronicity of anterior shoulder instability (acute ≤6 months versus chronic >6 months), experiencing one versus multiple prior anterior shoulder instability events, and experiencing glenohumeral subluxation (no manual reduction required) versus dislocation (manual reduction required). HSL medial-lateral width and cranio-caudal length were measured on axial and sagittal MRI respectively. HSL area (recorded in mm²) was calculated as HSL width times HSL length. Percent glenoid bone loss and distance-to-dislocation (DTD) of the HSL were additionally measured as previously described.(5) Univariate analysis was performed between chronicity groups, number of instability event groups, and dislocators versus subluxators using chi-square, Student t-tests, and Mann-Whitney U tests as appropriate. Significance was set to p<0.050.

RESULTS SECTION: After applying exclusion criteria, 255 patients (age: 22±8 years; 24% female) were included, of which 153 patients had acute instability and 102 patients had chronic instability. There was no association between acute versus chronic instability and HSL width (11.6 vs 12.4 mm; p>0.050), HSL length (16.4 vs 16.7 mm; p>0.050), and HSL area (201.6 vs 215.7 mm²; p>0.050), however DTD was significantly smaller in chronic instability patients (8.9 vs 10.5mm; p=0.021) (Table 1). While number of prior anterior shoulder instability events was not associated with HSL size, patients who experienced dislocation versus subluxation were found to have larger HSL length (16.7 vs 13.4mm; p<0.001), and area (201.9 vs 150.7mm²; p=0.012) (Table 1). Within-group analysis identified a smaller DTD in chronic versus acute dislocators (9.1 vs 10.9 mm; p=0.043), as well as a smaller DTD (9.0 vs 13.5 mm; p=0.005) and larger HSL width (12.3 vs 8.8 mm; p=0.009) in chronic versus acute subluxators.

DISCUSSION: HSL size was not associated with chronicity or number of anterior shoulder instability events, however was found to be larger in patients who experienced glenohumeral dislocation versus subluxation. This may be explained by the larger force required to sustain a glenohumeral dislocation versus subluxation, as well as the smaller force required to sustain subsequent anterior shoulder instability events after initial subluxation or dislocation event (6,7). Altogether, the findings of the present study suggest that HSL size may be influenced more by nature and degree of initial anterior shoulder instability event than the chronicity or number of subsequent instability events.

SIGNIFICANCE/CLINICAL RELEVANCE: Understanding the pre-operative factors that influence HSL size at time of imaging helps to guide surgical decision-making and patient counseling regarding appropriate timing of surgical intervention and factors that may propagate HSL size if left untreated.

REFERENCES: (1) Yamamoto et al, JSES 2007; Stefanik et al, JSES 2017; (3) Cong et al, AJSM 2024; (4) Steuer et al, AJSM 2025; (5) Boden et al, OJSM 2023; (6) McMahon et al, JSES 2013; (7) Yoshida et al, Clin Biomech 2019

<i>Anterior Shoulder Instability Chronicity</i>			
	Acute (n = 153)	Chronic (n = 102)	p-value
HSL Width (mm), mean (SD); range	11.6 (4.7); 2.0-23.8	12.4 (4.6); 2.0-24.0	0.196
HSL Length (mm), mean (SD); range	16.4 (5.8); 5.2-37.4	16.7 (5.6); 5.7-27.9	0.521
HSL Area (mm²), mean (SD); range	201.6 (134.5); 13.4-733.2	215.7 (117.4); 25.0-549.1	0.154
% Glenoid Bone Loss, mean (SD)	5.9 (6.3)	7.0 (5.5)	0.078
DTD (mm), mean (SD)	10.5 (5.5)	8.9 (5.2)	0.021
<i>Number of Prior Anterior Shoulder Instability Events</i>			
	One (n = 88)	Multiple (n = 167)	p-value
HSL Width (mm), mean (SD); range	11.7 (4.7); 2.1-23.8	12.0 (4.6); 2.0-24.0	0.611
HSL Length (mm), mean (SD); range	16.5 (5.8); 5.8-37.4	16.5 (5.7); 5.2-32.6	0.867
HSL Area (mm²), mean (SD); range	205.0 (133.5); 26.2-695.3	208.4 (123.2); 13.4-733.2	0.553
% Glenoid Bone Loss, mean (SD)	5.8 (5.9)	6.6 (6.1)	0.312
DTD (mm), mean (SD)	10.4 (5.2)	9.6 (5.6)	0.295
<i>Subluxation versus Dislocation</i>			
	Subluxation (n = 38)	Dislocation (n = 140)	p-value
HSL Width (mm), mean (SD); range	10.2 (4.2); 2.0-20.0	11.5 (4.3); 2.1-22.7	0.089
HSL Length (mm), mean (SD); range	13.4 (6.6); 5.7-37.4	16.7 (5.3); 7.1-32.6	<0.001
HSL Area (mm²), mean (SD); range	150.7 (120.1); 13.4-576.0	201.9 (123.6); 38.7-733.2	0.004
% Glenoid Bone Loss, mean (SD)	7.1 (6.0)	6.5 (6.2)	0.528
DTD (mm), mean (SD)	11.7 (4.8)	10.2 (5.2)	0.059
<i>MRI = magnetic resonance imaging, HSL = Hill-Sachs lesion; DTD = distance to dislocation; SD: standard deviation; mm: millimeters</i>			

Table 1. Comparison of Hill-Sachs Lesion Dimensions Based on Anterior Shoulder Instability Chronicity, Number of Prior Anterior Shoulder Instability Events, and Subluxation versus Dislocation