

Analysis of Scapula Morphology as a Key Factor in Unstable Painful Shoulder (UPS) using magnetic resonance imaging (MRI): Comparison with Anterior Shoulder Instability and Healthy Controls

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INTRODUCTION:

Unstable painful shoulder (UPS) was first concept proposed by Boileau et al. in 2011. According to their primary reports, UPS is defined as a condition characterized by pain as the chief complaint, without a subjective episode of dislocation or subluxation, but with imaging or arthroscopic findings indicative of shoulder instability, such as a “roll-over lesion” indicating Bankart or Hill-Sachs lesions. Hoshika et al. in 2021 added the criteria of a traumatic onset and pain during daily activities or sports to this definition. However, UPS has similar imaging or arthroscopic lesions to anterior shoulder instability, the factors contributing to the different symptoms in between UPS and anterior shoulder instability remain unclear. Generally, glenoid and humeral morphology, such as glenoid bone loss and Hill-Sachs lesions on the humeral head, is widely recognized as a risk factor for recurrent shoulder instability and plays an important role in instability. The purpose of this study was to investigate differences in scapular morphology between UPS and anterior shoulder instability using magnetic resonance imaging (MRI). We hypothesized that UPS has more anteriorly stable scapula morphology compared to normal shoulder and anterior shoulder instability.

METHODS: We retrospectively reviewed 2,278 patients who underwent shoulder MRI from approximately 5,400 new patients who had shoulder issues and visited our clinic for 10 years from January 2013 to December 2023. This study included 74 patients diagnosed with UPS defined by Boileau and Hoshika (U group), 81 patients with only one dislocation or subluxation episode of anterior shoulder instability (A group), and 24 controls with no history of shoulder pathology (C group). Furthermore, U group and AI group were limited to contact and collision sports and matched for sex, height, and age, 38 cases were selected from each group. 14 parameters related to the glenoid, acromion, and coracoid process were measured on MRI and subjected to statistical analysis among the three groups. Considering multicollinearity in post-hoc analysis, logistic regression analysis was performed on anatomical factors that showed significant differences between the U and A group, and the most significant associations with the outcome variables were identified.

RESULTS: The glenoid width and depth were significantly higher in the U group compared to the A and C groups (width [mm] : 28.1, 24.6, 25.7; depth [mm] : 2.5, 1.1, 1.4, respectively, $P < .001$, Table1). Anterior and posterior acromial coverage were significantly lower in the U group compared to the A and C groups (anterior [$^{\circ}$] : 4.5, 9.5, 9.1, posterior [$^{\circ}$] : 65.7, 70.7, 70.0, respectively, $P < .001$), while the posterior acromion height was significantly higher in the U group (16.4, 13.1, 12.7 mm, $P = .002$). No significant differences were observed among the three groups for the other parameters. Among all parameters, glenoid depth (odds ratio = 11.9; $P < .001$) showed the most significant association with UPS in the logistic regression model. Receiver operating characteristic (ROC) curve analysis identified a cutoff value of 1.25 mm to distinguish the U group from A group. The area under the curve was 0.818, and when 1.25 mm was used as the cutoff value, the sensitivity was 84.2% and the specificity was 60.5% (Figure 1).

DISCUSSION AND CONCLUSION: UPS is associated with deeper and wider glenoid, as well as a higher and more anteriorly covering acromion than normal shoulder and anterior shoulder instability. These results support the hypothesis that UPS has more anteriorly stable scapula morphology compared to normal shoulder and anterior shoulder instability. Among these parameters, the glenoid depth suggested the most significant association with UPS and may play a crucial role in instability. The stable scapula morphology in UPS, which is a deeper and wider glenoid, as well as a higher and more anteriorly covering acromion, may provide more osseous and muscular resistant against anterior humeral head translation. UPS has a stable scapula morphology, which makes it difficult to notice dislocation or subluxation, and symptoms may be reported as pain during activity and in abduction-external rotation positions rather than the feeling of instability associated with anterior shoulder instability. UPS was found to be associated with deeper and wider glenoid, as well as a higher and more anteriorly covering acromion, as measured on MRI. Understanding the characteristic morphology of UPS could improve the appropriate diagnosis and management of UPS in clinical practice.

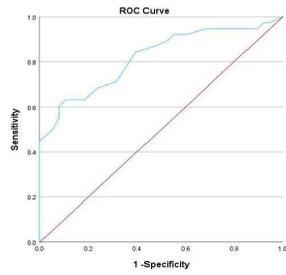


Figure 1. ROC analysis of glenoid depth as a predictor of unstable painful shoulder. Area under curve 0.916 (threshold of acceptability was >0.80) glenoid depth 1.25mm (arrow) was 91.2% sensitive and 60.5% specific for predicting unstable painful shoulder in this cohort.

Table 5
Comparison of scapula morphology between anterior shoulder instability, unstable painful shoulder, and control groups

Mean Measurement Values With SDs and 95% CIs*

	anterior shoulder instability (AI)		unstable painful shoulder (UPS)		control (C)		P Value
	Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI	
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