

# Does Scapular Upward Rotation Affect Subacromial Impingement in Lateralized Reverse Shoulder Arthroplasty?

Donghwan Lee<sup>1</sup>, Joo Han Oh<sup>2</sup>, Hyeon Jang Jeong<sup>2</sup>, Choongsoo S. Shin<sup>1,3</sup>

<sup>1</sup>Department of Mechanical Engineering, Sogang University, Seoul, Republic of Korea

<sup>2</sup>Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, Seongnam, Republic of Korea

<sup>3</sup>Research Institute for Smart Design & Manufacturing Technology, Sogang University, Seoul, Republic of Korea  
[dwan0513@sogang.ac.kr](mailto:dwan0513@sogang.ac.kr)

**Disclosures:** Donghwan Lee (N), Joo Han Oh (N), Hyeon Jang Jeong (N), Choongsoo S. Shin (N)

**INTRODUCTION:** Subacromial impingement (i.e., mechanical contact between the acromial undersurface and the greater tuberosity of the humerus) can occur during abduction following lateralized reverse shoulder arthroplasty (RSA) [1,2]. However, it remains unclear how alterations in scapular upward rotation influence subacromial impingement. This study aimed to investigate the effects of different degrees of scapular upward rotation on subacromial impingement, initial contact angle, and peak contact angle in lateralized RSA. We hypothesized that increasing the upward rotation would decrease subacromial impingement.

**METHODS:** A musculoskeletal shoulder model of lateralized RSA (Coralis<sup>®</sup> Reverse Shoulder System; Corentec Co., Ltd., Seoul, Republic of Korea) was developed using a single standard configuration of the lateralized glenoid and humerus. Twelve male *in vivo* experimental datasets, collected during 120° of abduction in the scapular plane, were used as consistent inputs for the model. Subacromial contact pressure was calculated to quantify subacromial impingement. Three scapulohumeral rhythm (i.e., the ratio of scapulothoracic to glenohumeral elevation) models were simulated with varying scapular upward contributions: low (1:2.4), medium (1:2.0), and high (1:1.6). Repeated-measures ANOVA was conducted to determine differences between the models. Post hoc paired t-tests with false discovery rate correction were performed to compare peak subacromial contact pressure, initial contact angle, and peak contact angle.

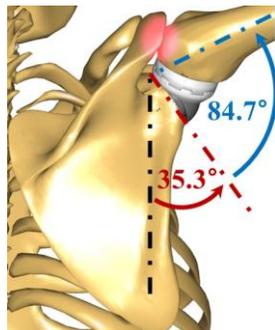
**RESULTS:** The low-contribution model showed the highest peak subacromial contact pressure (8.2 ± 0.9 MPa), significantly greater than both the medium-contribution (5.3 ± 0.5 MPa; *P* = 0.001) and high-contribution (3.7 ± 0.6 MPa; *P* = 0.001) models. The earliest initial contact was observed at 76.7 ± 4.1° in the low-contribution model compared to the medium-contribution (87.0 ± 3.2°; *P* < 0.001) and high-contribution (99.6 ± 3.0°; *P* < 0.001) models. No significant differences in the peak contact angle were found across the contribution models (low: 118.9 ± 1.9°, medium: 118.7 ± 2.1°, and high: 118.2 ± 2.7°).

**DISCUSSION:** Increasing scapular upward rotation significantly decreases subacromial contact pressure and delays the onset of initial contact during abduction. Subacromial impingement is associated with the development of subacromial notching, resulting in adverse clinical outcomes in patients with lateralized RSA [2]. Therefore, our results suggest that enhancing scapular upward contribution can reduce subacromial impingement in lateralized RSA. These findings highlight implications for designing rehabilitation programs aimed at minimizing the risk of subacromial impingement in this patient population.

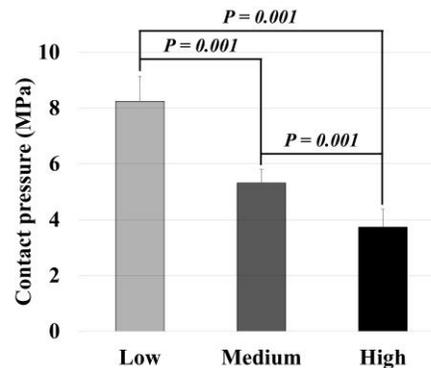
**SIGNIFICANCE/CLINICAL RELEVANCE:** Improving scapular upward rotation may mitigate subacromial impingement in patients with lateralized RSA.

**REFERENCES:** [1] Lädermann et al., *Int Orthop.*, 2015;39(11):2205-2213. [2] Jeong et al., *J Shoulder Elbow Surg.*, 2023;32(9):1876-1885.

**ACKNOWLEDGEMENTS:** This research was supported by the National Research Foundation of Korea grant funded by the Ministry of Science and Information Communication Technology (RS-2024-00342681).



**Fig. 1.** Illustration of subacromial impingement during abduction in the low-contribution (scapulohumeral rhythm of 1:2.4) model.



**Fig. 2.** Comparison of peak subacromial contact pressure.

**Table 1.** Comparison of initial and peak contact angles during abduction across three contributions of scapular upward rotation in the musculoskeletal shoulder model of lateralized reverse shoulder arthroplasty.

Variable	Comparison	Angle (°)	<i>P</i> -value
<b>Initial contact</b>	Low vs. Medium	76.7 ± 4.1° vs. 87.0 ± 3.2°	< 0.001
	Low vs. High	76.7 ± 4.1° vs. 99.6 ± 3.0°	< 0.001
	Medium vs. High	87.0 ± 3.2° vs. 99.6 ± 3.0°	0.001
<b>Peak contact</b>	Low vs. Medium	118.9 ± 1.9° vs. 118.7 ± 2.1°	0.2
	Low vs. High	118.9 ± 1.9° vs. 118.2 ± 2.7°	0.2
	Medium vs. High	118.7 ± 2.1° vs. 118.2 ± 2.7°	0.2

Data are presented as mean ± standard deviation.