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ORIGINAL ARTICLE

Critical shoulder angle in an East Asian population: correlation to the incidence of rotator cuff tear and glenohumeral osteoarthritis

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Background: Focus has recently been on the critical shoulder angle (CSA) as a factor related to rotator cuff tear and osteoarthritis (OA) in the European population. However, whether this relationship is observed in the Asian population is unclear.

Methods: The correlation between the CSAs measured on anteroposterior radiographs and the presence or absence of rotator cuff tears or OA changes was assessed in 295 patients. Rotator cuff tears were diagnosed with magnetic resonance imaging or ultrasonography. OA findings were classified using the Samilson-Prieto classification. The CSAs among the patients with rotator cuff tears, OA changes, and those without pathologies were compared. Multivariable analyses were used to clarify the potential risks for these pathologies.

Results: The mean CSA with rotator cuff tear (33.9° ± 4.1°) was significantly greater than that without a rotator cuff tear (32.3° ± 4.5°; $P = .002$). Multivariable analysis also showed that a greater CSA had a significantly increased risk of rotator cuff tears, with the odds ratio of 1.08 per degree. OA findings showed no significant correlation to the CSAs.

Conclusions: Our study demonstrates that the CSA is greater in those with a rotator cuff tear than in those without a tear or OA changes, which may be an independent risk factor for the incidence of rotator cuff tears in the Japanese population.

Level of evidence: Level III; Cross-Sectional Design; Prognosis Study

Keywords: Critical shoulder angle; shoulder; rotator cuff tear; osteoarthritis; East Asian; radiograph

Shoulder pathologies, including rotator cuff disease and glenohumeral osteoarthritis (OA), are multifactorial.[12,16,26] In addition to aging or habitual factors,[13,21] focus has been on anatomic variation of the acromion for the potential relation to these shoulder pathologies. For stratifying or quantifying the acromial variation, several assessments, including the acromial type,[3] the acromial tilt,[1] and the acromial index,[22] have been suggested.

The Oshu City Mizusawa Hospital Institutional Review Board approved this study (OCMH-H29-1).

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More recently, the critical shoulder angle (CSA), defined by the angle between a line connecting the superior to the inferior margins of the glenoid and a line connecting the inferior margin of the glenoid to the inferolateral edge of the acromion, has been advocated to quantify the combination of glenoid inclination and lateral extension of the acromion.[18] Notably, some studies demonstrated the CSA could be a powerful predictor of rotator cuff tears and primary OA by revealing their characteristic CSA patterns: a larger CSA with rotator cuff tears and a smaller CSA with OA.[2,9,14,20] In contrast, other studies suggested the effect of this congenital factor on shoulder pathologies could be not significant.[8] Moreover, whether CSA could be standardized among the whole populations is still unclear after a recent study reported the CSA was significantly different between North American and East Asian populations.[7] Most studies to date supporting the use of CSA have been conducted in North American or European countries; therefore, an investigation for other populations would be required.[2,9,14,20]

We hypothesized that the CSA in the East Asian population could be associated with the prevalence of shoulder disorders, including rotator cuff tears or shoulder OA. In addition, increased or decreased CSAs in East Asian population could show significant risks for these shoulder disorders. Therefore, the purposes of this study were (1) to investigate whether increased or decreased CSAs would have similar relationships with rotator cuff tears and OA findings in Japanese patients and (2) to clarify the potential risk of CSA for the occurrence of these pathologies by using multivariate analysis.

Materials and methods

Our study cohort included patients aged >50 years who were seen in our institution due to shoulder pain from January 2013 to December 2014. Patients with avascular necrosis or severe deformity of the glenoid and the humerus were excluded.

Information obtained from patients at the initial visit included age, sex, height, weight, and smoking history. All patients underwent a shoulder x-ray examination, including standardized anteroposterior, axial, and scapular Y views. Of these, we included patients who underwent diagnostic assessments for the rotator cuff tear, including ultrasonography or magnetic resonance imaging (MRI), or both. Rotator cuff conditions were interpreted by 1 of 3 orthopedic surgeons (E.I., N.Y., M.M.) using ultrasonography or by a radiologist using MRI. Rotator cuff tears were were categorized into full-thickness or partial-thickness tears.

Measurement of the CSA

The CSA was measured on the anteroposterior radiograph for each patient, according to the established method by Moor et al,[18] and assessed for its correlation to the prevalence of shoulder pathologies. Zio Term 2009 software (Ziosoft, Tokyo, Japan) was used to construct a line that connected the superior and inferior osseous margins of the glenoid cavity and another line from inferolateral border of the acromion were drawn. Thus, both lines intersected at the inferior glenoid margin, and the angle between the lines was measured as the CSA (Fig. 1).

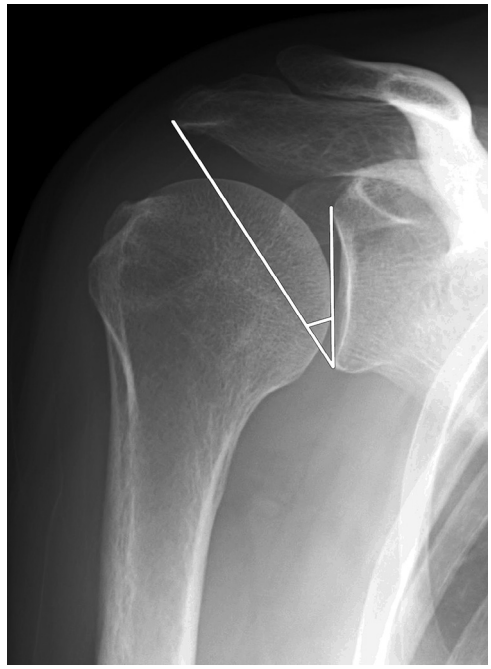

Figure 1 The angles between a line connecting the superior and inferior osseous margins of the glenoid cavity and another line from the inferolateral border of the acromion were measured as the critical shoulder angle.

For this study, 2 orthopedic surgeons (K.S., T.H.) independently measured the CSA for all patients, and the mean values were calculated to obtain the CSA for the subsequent analyses. In addition, 1 surgeon (K.S.) repeated the measurement twice within a 2-week interval to assess intraobserver reproducibility. Thus, intraobserver and interobserver reliabilities for the CSA measurement were also evaluated.

CSA assessment in association with shoulder pathologies

Patients in this study were classified according to the presence of absence of rotator cuff tears as the cuff tear group (RCT) and intact cuff group (non-RCT). The non-RCT patients were further classified by OA findings. The anteroposterior radiographs were used to stratify the extent of OA findings into 4 grades according to the Samilson-Prieto classification[23]: grade 0, none; grade 1, mild OA with osteophytes <3 mm on the humeral head; grade 2, moderate with osteophytes between 3 and 7 mm on the humeral head or glenoid rim; and grade 3, severe with osteophytes >7 mm, with or without articular incongruity.

Statistical analyses

Statistical analyses were performed using SPSS 18.0 (IBM, Armonk, NY, USA), GraphPad Prism 5.0 (GraphPad Software, La Jolla, CA,