J Shoulder Elbow Surg (2016) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Glenoid deformity in the coronal plane correlates with humeral head changes in osteoarthritis: a radiographic analysis

Nael Hawi, MD[a,b,*], Petra Magosch, MD[c,d], Mark Tauber, MD[a,e], Sven Lichtenberg, MD[c], Frank Martetschläger, MD[a], Peter Habermeyer, MD[a]

[a]*Department of Shoulder and Elbow Surgery, ATOS Clinic Munich, Munich, Germany*
[b]*Trauma Department, Hannover Medical School, Hannover, Germany*
[c]*Department of Shoulder and Elbow Surgery, ATOS Clinic Heidelberg, Heidelberg, Germany*
[d]*University Medical Centre Mannheim, University of Heidelberg, Heidelberg, Germany*
[e]*Department of Traumatology and Sports Injuries, Paracelsus Medical University, Salzburg, Austria*

Background: A variety of measurements can be used to assess radiographic osteoarthritic changes of the shoulder. This study aimed to analyze the correlation between the radiographic humeral-sided Samilson and Prieto classification system and 3 different radiographic classifications describing the changes of the glenoid in the coronal plane.

Methods: The study material included standardized radiographs of 50 patients with idiopathic osteoarthritis before anatomic shoulder replacement. On the basis of radiographic measurements, the cases were evaluated using the Samilson and Prieto grading system, angle β, inclination type, and critical shoulder angle by 2 independent observers.

Results: Classification measurements showed an excellent agreement between observers. Our results showed that the humeral-sided Samilson and Prieto grading system had a statistically significant good correlation with angle β (observer 1, $r = 0.74$; observer 2, $r = 0.77$; $P < .05$) and a statistically significant excellent correlation with the inclination type of the glenoid (observer 1, $r = 0.86$; observer 2, $r = 0.8$; $P < .05$). A poor correlation to the critical shoulder angle was observed ($r = -0.14$, $r = 0.03$; $P > .05$).

Conclusions: The grade of humeral-sided osteoarthritis according to Samilson and Prieto correlates with the glenoid-sided osteoarthritic changes of the glenoid in the coronal plane described by the angle β and by the inclination type of the glenoid. Higher glenoid-sided inclination is associated with higher grade of osteoarthritis in primary shoulder osteoarthritis.

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

Keywords: Glenohumeral osteoarthritis; radiographic classification; inclination type; angle β; critical shoulder angle; Samilson and Prieto; shoulder; osteoarthritis

Approval for this study was awarded by the Ethic Commissions of the Hannover Medical School and the ATOS Clinics. All patients were informed and gave their consent.

*Reprint requests: Nael Hawi, MD, Trauma Department, Hannover Medical School, Carl-Neuberg-Str. 1, D-30625 Hannover, Germany.

E-mail address: hawi.nael@mh-hannover.de (N. Hawi).

Glenohumeral arthritic joint disease is a common shoulder disorder. Therapeutic options include joint-preserving approaches that vary by stage and the patient's age as well as joint replacement procedures.[1,17,21] To determine stage,

1058-2746/$ - see front matter © 2016 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2016.07.007

osteoarthritis of the shoulder is often defined using radiographic examination, following the grading system of Samilson and Prieto,[18] which was originally introduced to evaluate instability arthropathy by describing the humeral-sided size of the osteophyte.

On the other hand, several authors have reported different methods of radiographic evaluation of the scapular anatomy. Ricchetti et al[16] described that patients with glenohumeral osteoarthritis do not appear to have abnormal premorbid glenoid inclination or retroversion. Edelson[4] described a relationship between posteroinferior glenoid wear and osteoarthritis in the glenohumeral joint.

Habermeyer et al[8] introduced a classification system for grading of the glenoid inclination type based on the intersection of a vertical line at the base of the coracoid process and a line at the glenoid rim. This classification system combines the inclination of the glenoid in the coronal plane with the inferior protrusion of the humeral head respectively glenoid. Concerning scapular-specific anatomy, Maurer et al[13] analyzed several radiographic measurements and described angle β (the angle between the floor of the supraspinatus fossa and the glenoid fossa line) as a reproducible indicator of glenoid inclination. Finally, Moor et al[14] described a radiographic parameter—the critical shoulder angle—that combines the glenoid inclination and the lateral extension of the acromion (acromion index).

Osteoarthritic changes of the glenoid in the axial plane are already described in the literature.

This study aimed to determine the correlation of humeral-sided arthropathy according to Samilson and Prieto with glenoid-sided pathology in primary osteoarthritis based on angle β according to Maurer et al,[13] inclination type according to Habermeyer et al,[8] and critical shoulder angle according to Moor et al.[14]

Materials and methods

Our study material included radiographs of 68 consecutive patients with osteoarthritis before anatomic shoulder arthroplasty in a retrospective study design. All patients had no previous surgical intervention of the shoulder. All radiographs were analyzed in the true anteroposterior view. Seven patients with post-traumatic osteoarthritis and 3 patients with osteonecrosis were excluded from this study. Four patients were excluded because of an upward-tilted glenoid, which is described by the classification system of Favard et al[6,7] and is not included in the classification system of the inclination type described by Habermeyer et al.[8] Four patients were excluded from the study because of an insufficient radiograph. The mean age of the patients was 70.4 ± 9.2 years, and the gender distribution was 24 female and 26 male patients. Twenty-one arthroplasties were performed on the right shoulder and 29 on the left shoulder.

Measurements were performed by 2 independent shoulder-trained orthopedic surgeons (N.H. and F.M.). The cases were categorized by several systems: classification according to Samilson and Prieto,[18] with the modification of adding grade IV for all patients having an inferior humeral osteophyte extending >12 mm; angle β according to Maurer et al[13]; inclination type according to Habermeyer et al[8]; and critical shoulder angle according to Moor et al.[14] Figure 1 shows examples of these classifications.

Radiographic and measurement techniques

A true anteroposterior radiograph was acquired of all patients in a standing upright position. The scapula was situated against the cassette of the X-ray behind the patient. The patient's arm was positioned at the side in strictly neutral rotation. The beam was passed in an anterior to posterior direction, tilted caudal 10° from the perpendicular line to the scapula. Trained and experienced staff performed all radiographs.

Samilson and Prieto classification of humeral-sided arthropathy[18]

The Samilson and Prieto classification system grades an inferior humeral head osteophyte by millimeters of extension. In the original system, an extension of <3 mm is considered grade I; 3 to 7 mm, grade II; and >7 mm, grade III. To emphasize the degree of osteoarthritis and to allow a proper discrimination between groups, we modified this classification and included the classification of an osteophyte between 8 and 12 mm as grade III and that >12 mm as grade IV (Table I).

Angle β as described by Maurer et al[13]

Angle β was measured as the degree of the angle between the floor of the supraspinatus fossa (sclerotic line) and a line drawn along the superior and inferior glenoid tubercle (rim line).

Inclination type as described by Habermeyer et al[8]

Inclination type was determined on the basis of the relationship between a vertical line set at the lateral base of the coracoid process, perpendicular to the radiograph bottom margin, and a line drawn along the superior and inferior glenoid tubercle. Parallel lines were classified as type 0. In cases of line intersection, the type was determined by where that intersection occurred, with intersection below the inferior glenoid rim considered type I, intersection between the inferior rim and the center of glenoid considered type II, and intersection above the coracoid base considered type III.

Critical shoulder angle as described by Moor et al[14]

Critical shoulder angle was measured as the degree of the angle between a line from the inferior glenoid rim and the most lateral border of the acromion and a line drawn along the superior and inferior glenoid tubercle.

Statistical methods

Descriptive analyses were performed and all data are presented as mean, range, and standard deviation. Spearman correlation was used to analyze the relationships between classification methods (Samilson and Prieto, angle β, inclination type, and critical shoulder angle). Interobserver reliability was assessed using intraclass correlation