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The osseous morphology of nondegenerated shoulders shows no side-related differences in elderly patients: an analysis of 102 computed tomography scans

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Background: A precise understanding of glenohumeral anatomy is required to optimize preoperative planning in shoulder joint arthroplasty, which is difficult in the presence of degenerative disease. In unilateral disease, the contralateral shoulder can be used as a representation of normal anatomy; however, intrasubject differences in shoulder morphology have not been investigated.
Methods: A retrospective study of all patients aged >65 years who received whole body computed tomography at our trauma center from 2010 through 2014 was conducted. Right and left shoulder computed tomography scans were examined, and the following anatomic parameters were measured: humeral head diameter in anteroposterior and axial views, glenoid diameter in anteroposterior and axial views, glenoid surface, scapula neck depth, neck-shaft angle, glenoid inclination, glenoid/head ratio, and glenoid version. Patients with inadequate scan quality, osseous lesions, pre-existing anatomic abnormality, or metallic implant at the shoulder region and significant osteoarthritis were excluded.
Results: The study analyzed 102 shoulders of 51 patients. Mean age was 71.4 ± 8.2 years. Humeral head and glenoid diameters, scapula neck depth (right, 36 ± 8 mm; left, 36 ± 7 mm; $P = .684$), glenoid/head ratio (right, 0.6 ± 0.1; left, 0.6 ± 0.0; $P = .961$), and glenoid surface (right, 790 ± 152 mm^2; left, 754 ± 134 mm^2; $P = .215$) showed no significant side-related differences. In addition, no significant difference was found regarding the neck-shaft angle ($P = .211$) and glenoid anteversion or retroversion (right, 65% [n = 33] anteversion and 35% [n = 18] retroversion; left, 69% [n = 35] anteversion and 31% [n = 16] retroversion; $P = .417$).
Conclusion: There are no significant side-dependent differences in the osseous anatomy of the glenohumeral joint. In patients with unilateral shoulder degeneration, the contralateral shoulder can provide reference values during the planning of shoulder replacement surgery.

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Degenerative joint disease is becoming more prevalent in aging populations worldwide. This, along with recent advances in implant technology and surgical technique, has led to an increase in the number of shoulder joint arthroplasties performed to improve joint pain and function.[13] In arthroplasty, it is accepted that the accurate positioning and sizing of the implant are critical to achieve a good outcome, and deficiencies in this can lead to ongoing pain, poor function, and implant failure postoperatively.[22] Precise preoperative planning is therefore crucial.[13,16] However, in the presence of advanced glenohumeral joint degenerative disease, the exact assessment of key anatomic structures is limited by the structural abnormality of the joint. In this eventuality, the contralateral side, if normal, is often used as a template, with the assumption that there is little intrasubject variability in glenohumeral anatomy. With a paucity of evidence in the literature regarding intrasubject anatomic variability of glenohumeral joint anatomy, this study aims to determine whether there are significant anatomic differences in the general population.

Materials and methods

We conducted a retrospective radiologic study, between January 2010 and December 2014, of 53 patients who underwent whole body computed tomography (CT) scan in our center after multiple trauma (Fig. 1).

Inclusion criteria were age ≥65 years and available whole body CT scan. Exclusion criteria were age <65 years, inadequate scan quality (eg, motion artifact or failure to include the glenohumeral joint in its entirety), osseous lesion in the shoulder region, metallic implant in the shoulder region, pre-existing abnormality in the shoulder region, and osteoarthritis higher than level B1 as described by Walch.[21]

Radiographic assessment used a 128-slice CT scanner (Somatom Volume Zoom; Siemens Medical Solutions, Erlangen, Germany) with intravenous administration of a contrast agent. Chest, abdomen, and pelvis were scanned from the C6 vertebra to the groin (chest scan, 25 seconds after administration of the contrast agent in the arterial phase; abdomen and pelvis scan, 60 seconds after administration of the contrast agent during the venous phase). The patients' hands were positioned with the palms placed on each side of the pelvic brim. Slice thickness was 2.5 mm. The scans were reviewed at a digital working station using IMPAX (IMPAX EE; Agfa Healthcare GmbH, Bonn, Germany), and measurements were taken by 2 independent observers.

Anatomic parameters to assess the glenohumeral anatomy were recorded as follows.[2]

Bone size

Humeral head diameter (anteroposterior and axial): a line was drawn along the longest head diameter through the anatomic neck in the coronal plane and from the greater tuberosity to the opposite cortex in the axial plane (Fig. 2, *a* and *b*).[5,14]

Glenoid diameter (anteroposterior and axial): a line was drawn along the longest glenoid diameter in the coronal and axial plane (Fig. 2, *c* and *d*).[18]

Glenoid surface: the glenoid surface was considered elliptical and measured by analyzing the maximum craniocaudal diameter in coronal view and the maximum anterior-posterior diameter in axial view.[8]

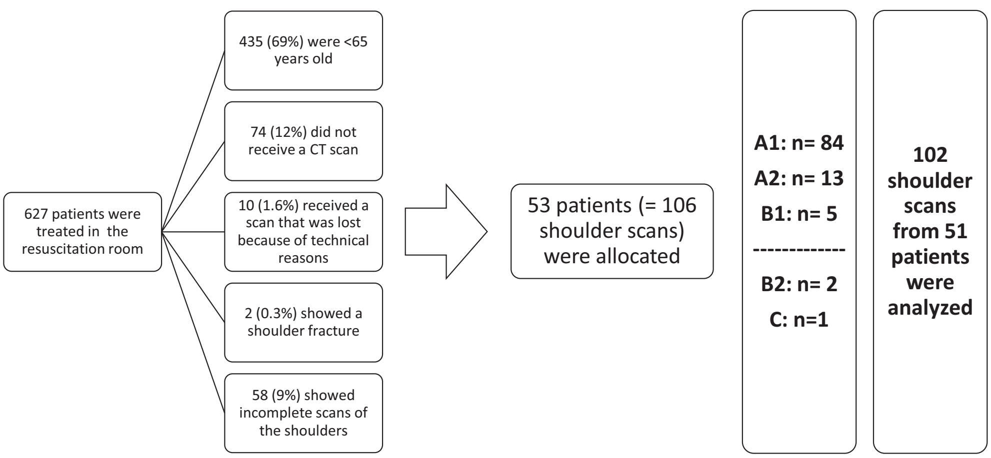

Figure 1 Flow chart depicting the identification of patients and the inclusion-exclusion process.