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Original article

Is anterior glenoid bone block position reliably assessed by standard radiography? A cadaver study

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ABSTRACT

Background: Standard radiography with an antero-posterior view and Bernageau's glenoid profile view is the method most widely reported in the literature to assess coracoid bone block position and fusion.
Objective: The aim of this cadaver study was to determine whether the antero-posterior and Bernageau's radiographs provide a reliable and reproducible evaluation of the position of a coracoid bone block and its fixation screws.
Method: An isolated scapula showing no evidence of osteoarthritis or other abnormalities was used. The coracoid process was transferred to the anterior glenoid rim. Fixation was with two slightly diverging malleolar screws, chosen of different sizes for ease of identification. Computed tomography (CT) was performed as the reference imaging technique. The standard radiographs were then obtained, using fluoroscopy to accurately position the scapula for the antero-posterior and Bernageau's views. This position was defined as 0°, and radiographs were taken at angles of 5°, 10°, and 15° in all three planes. All radiographs were taken during a single session to ensure that the distance separating the tube from the scapula remained unchanged. The images were exported to OsiriX for analysis. We measured the angles formed by the screws and the glenoid surface, as well as bone block position and overhang. Finally, we used 1-mm thick disks to evaluate bone-to-bone contact.
Results: No correlations were found between values by CT and by standard radiography (both views) for the screw angles or overhang. A space ≤ 1 mm between the neck of the scapula and the bone block was not visible on the standard radiographs in any of the positions.
Conclusion: Standard radiography does not provide an accurate analysis of bone block position or bone-to-bone contact. CT is needed to assess bone block and screw position and bone-to-bone contact.
Level of evidence: Level III.

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1. Introduction

Standard radiography has long held pride of place for evaluating bone block position and fusion after the Latarjet procedure [1–6]. An antero-posterior (AP) view and glenoid profile view as described by Bernageau are used. The precision and accuracy of measurements made on standard radiographs depend on the position of the scapula relative to the film, which varies significantly with the position of the patient, position of the arm relative to the torso, and direction of the X-ray beam. Ideally, fluoroscopy should be used to position the patient for the double-oblique AP view and Bernageau's view. Nevertheless, this precaution is omitted in some centres. Errors and poor reproducibility may therefore occur when assessing bone block position and screw direction in the three planes.

The hypothesis tested in this cadaver study is that standard radiography accurately evaluates bone block and screw position, i.e., provides measured values similar to those obtained using computed tomography (CT). The primary objective of this study was to determine whether the strict AP view and Bernageau's and Lamy's lateral views provide reliable information on bone block

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position. The secondary objectives were to assess the reproducibility of bone block and screw position measurements and to assess contact between the deep surface of the block and the neck of the scapula.

2. Material and methods

2.1. Preparation of the specimen

An isolated scapula from a donor was used. There was no evidence of osteoarthritis or other abnormalities. All soft tissues were removed. A bony Bankart-type lesion was then created in the anterior-medial border of the glenoid cavity, shifting the neck to the vertical direction [7]. The coracoid process was cut at its base. The horizontal limb of the coracoid process was then transferred to the glenoid rim, after smoothing its undersurface to produce a perfectly level surface. Fixation was with two slightly diverging malleolar screws, of different sizes for ease of identification (34 mm and 36 mm) (Fig. 1).

All standard radiographs were obtained during a single session to ensure that the position of the scapula and its distance from the tube remained unchanged.

2.2. CT assessment of bone block position and contact

CT was performed to serve as the reference (Siemens Medical, Malvern, PA, USA; 130 kV and slice thickness 1.0 mm). The scapula was placed horizontally on the table to replicate the supine position. Reconstructions were produced from native axial images. Finally, we used disks measuring 1, 2, and 3 mm in thickness to assess contact between the bone block and neck.

The images were exported in DICOM format (Digital Imaging and Communications in Medicine) for processing and analysis using OsiriX software (version 4.1.2, 32 bits). We used the reconstruction tools to obtain the AP view (oblique sagittal view) that served to define the vertical axis of the glenoid cavity and the equator. The plane of the glenoid cavity was defined on the native slices.

We measured the following on all views:

- angle formed by each screw and the glenoid surface (on the coronal and sagittal slices);
- position of the bone block (on the AP view relative to half the glenoid surface area) and overhang relative to the glenoid rim (axial slice);
- contact, as the distance between the undersurface of the coracoid process and the neck of the scapula (axial slice).

2.3. Definitions of radiographic incidences and measurements

The scapula was positioned on the radiography table and held in place using radiolucent blocks (Fig. 1).

2.3.1. AP view

A double-oblique AP view was taken, with lateral obliquity (obtained by turning the scapula about 30° towards the side to be studied, so that the beam was tangent to the anterior and posterior glenoid borders and the gleno-humeral joint space was visible) and cranio-caudal obliquity (obtained by inclining the tube downwards by 25° to avoid bony superimpositions in the subacromial space).

2.3.2. Lamy's lateral view (scapular Y view)

The beam is parallel to the long axis of the supra-spinatus muscle, tangential to the body of the scapula, and horizontal; fluoroscopy is needed to position the scapula correctly for this view.

2.3.3. Bernageau's view (glenoid profile view) [8–10]

A true lateral view is obtained when the inferior part of the anterior glenoid rim projects anteriorly to the rounded image formed by the upper part of the anterior glenoid rim.

The above-described positions were taken as the reference positions, i.e., 0°. Radiographs were then obtained after adding 5°, 10°, and 15° of anteversion, retroversion, flexion, and extension to the 0° position, for both the true AP and Bernageau's views (Figs. 2 and 3). The radiographs were digitised and exported to OsiriX. Compared to the 0° position, rotations were given a positive sign for anteversion and flexion and a negative sign for retroversion and extension.

Fig. 1. Preparation of the specimen and installation before taking the radiographs.

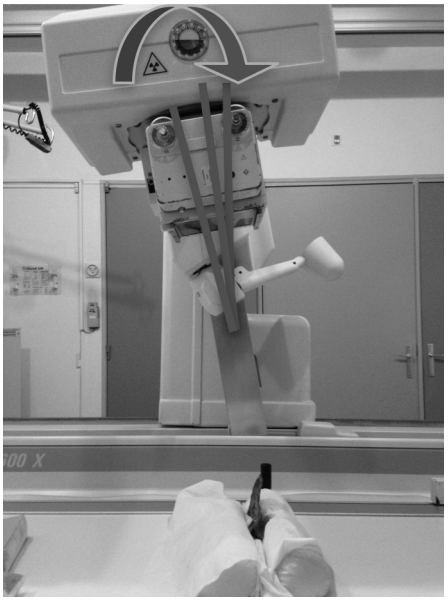

Fig. 2. Installation on the radiography table and positioning of the X-ray source under fluoroscopic guidance. The protractor serves to adjust tube inclination.

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