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Original Article

New multidetector computed tomography quantitative technique in evaluation of shoulder instability

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ABSTRACT

Aim: This study aimed to assess the role of multidetector computed tomography (MDCT) in detection and evaluation of severity of glenoid and humeral head bone loss in cases of recurrent anterior shoulder joint dislocation.

Patients and methods: Twenty four patients were included in the study. MDCT with 3D VR examination was performed to both shoulders of all patients. The area of the missing glenoid was calculated as well as glenoid track and Hill-Sachs interval in cases of humeral head bone loss. The findings were compared with the intra operative arthroscopic results.

Results: MDCT could detect minimal glenoid bone loss in 19 patients (79.2%), moderate glenoid bone loss in 4 patients (16.7%) and severe glenoid bone loss in 1 patient (4.2%), while arthroscope detected minimal loss in 16 patients (66.7%), moderate glenoid bone loss in 7 patients (29.2%) and significant glenoid bone loss in 1 patient (4.2%). Off-track Hill-Sachs lesions were detected by MDCT in 40% of patients and reduced to 35% of patients by arthroscopy.

Conclusion: MDCT is an optimal imaging modality in preoperative evaluation of glenoid and humeral head bone loss. It is the most accurate radiologic method in evaluating the new concepts of on-track and off- track Hill-Sachs lesions.

1. Introduction

The glenohumeral joint has the greatest range of motion of any major articulation in the human body. Dynamic stabilizers of the joint, including the rotator cuff muscles, are insufficient to maintain normal glenohumeral location and function [1]. Joint stability also depends on the passive constraints provided by intact static structures, especially the glenoid rim, glenoid labrum, and glenohumeral ligaments [1].

Glenohumeral instability can become the immediate sequelae of traumatic injury or evolve gradually owing to cumulative stresses related to occupational or sport-specific activities [1].

An associated glenoid rim fracture may compromise the fundamental static restraints of the glenohumeral joint after traumatic anterior shoulder dislocation, making future shoulder instability events more likely. Over time, recurrent dislocations may further propagate attritional bone loss, leading to additional instability [2].

As a potential complication of an anterior shoulder dislocation, the soft bone of the humeral head impacts against the dense cortical bone of the anterior glenoid rim causing compression fracture of the superior aspect of the posterolateral humeral head (Hill-Sachs lesions HSL) and avulsion of the anteroinferior glenoid labrum at its attachment to the inferior glenohumeral ligament complex and potentially injury to the bony glenoid itself (Bankart lesions) [3].

Unipolar bone loss is the partial loss of the glenoid (bony Bankart) or humeral head (Hill–Sachs lesion), bipolar bone loss is the association of both lesions, and it is caused by impaction of the posterolateral humeral head on the anteroinferior glenoid rim during recurrent anterior dislocation. The on-track and off-track lesions are depending on calculation of glenoid track (which is the contact area between glenoid bone and humeral head while the arm is in maximum external rotation, maximum horizontal extension and from 0 to 90 degrees in abduction position). In normal shoulders glenoid track is equal to 83% of glenoid width [4].

The Hill Sachs interval (HSI) is the width of the Hill Sachs fracture plus the intact bony bridge between the Hill–Sachs lesion and the medial border of greater tuberosity at site of rotator cuff attachment (foot print area). If the Hill–Sachs lesion is smaller than and lies within the true glenoid track, it is considered an on-track lesion. While the off-track lesion is considered when the Hill–Sachs lesion is larger than and extends more medial over the medial margin of the glenoid track [4].

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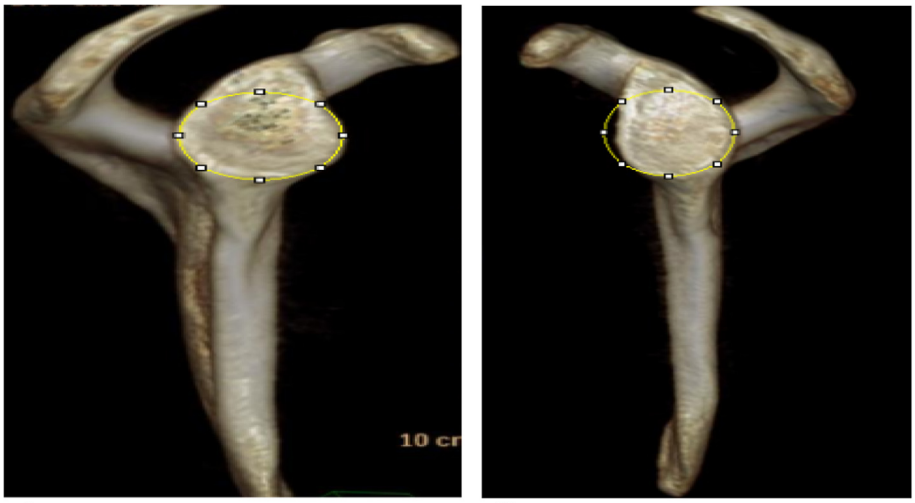

Fig. 1. Circumference of the contralateral normal inferior glenoid circle is determined based on the intact 3–9 o'clock margin (A) with transferring the circle to the injured glenoid (B).

Fig. 2. Percentage of glenoid bone loss = (d/D) × 100. Glenoid track calculation: GT = 0.83D-d.

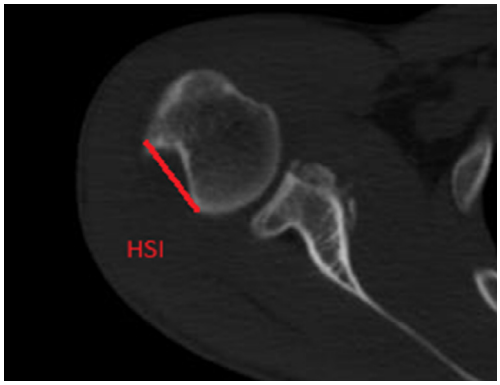

Fig. 3. Estimation of HSI in MDCT axial image (red line). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The principles of surgical management in patients with recurrent anterior shoulder instability are guided by the extent of glenoid osseous deficiency, in addition to other factors such as on-track vs off-track humeral bone defects, surgeon experience, and patient-specific considerations such as work and athletic demands [5].

The importance of recognizing glenoid bone loss as a risk factor for failure of standard soft tissue stabilization procedures has been stressed by many authors, therefore; accurate preoperative quantification of glenoid bone loss is important to reduce this risk after surgical stabilization [6]. Quantification techniques of glenoid osseous deficiency are still somewhat limited, primarily because of the non-geometric shape of the glenoid [7].

This study aimed to evaluate the role of 3-dimensional multidetector computed tomography (3DMDCT) in detection and assessment of severity of glenoid and humeral head bone loss in cases of recurrent shoulder joint dislocation and correlated the results with arthroscopic findings.

1.1. Patients and methods

This study included 24 patients with recurrent shoulder dislocation, 22 males and 2 females. Their ages ranging from 19 to 61 years old with a mean of 28.12 years.

- **Patient inclusion criteria**:
  - o Patients whose physical examination findings are positive for recurrent shoulder dislocation.
  - o Adult patients with no sex predominance.
- **Patient exclusion criteria**:
  - o Patients unfitted for arthroscopic evaluation.
  - o Patients with bilateral recurrent shoulder joint instability.

After obtaining institutional review board approval from our hospital and informed consent from patients before study. All the patients were subjected to multidetector CT scan of both shoulders. All the CT scans were acquired with a 128 multi-detector row CT scanner (**PHILIPS ingenuity$^{core\ 128TM}$ slice CT scanner)**.

Patient position: Supine position, head first towards the gantry.

Arms at sides of the body and immobilized in neutral rotation by an elastic bandage. A small pad placed below the elbow and a pillow placed below the knees afford a more comfortable position for the patient. Cervical spine is in neutral position.

Image acquisition: Antroposterior scanning is used to obtain the axial images, both shoulders were scanned simultaneously. Post processing multiplanner reconstruction (MPR) were obtained using the machine software in coronal and sagittal planes. Via the picture archiving and communication system (PACS) a reconstructed 3D images were available. 3D images are used to assess glenoid bone loss using glenoid articular surface (en face view) with humeral head subtraction.