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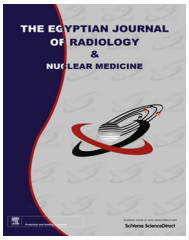

ORIGINAL ARTICLE

Assessment of acromial morphology in association with rotator cuff tear using magnetic resonance imaging

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KEYWORDS

Acromioal morphology;
Rotator cuff tear;
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Abstract *Purpose:* To identify the morphological characteristics of the acromion associated with RCT using MRI. Also, to recognize which type of the acromion could be risk factor for full thickness RCT.

Materials and methods: Fifty-six patients with RCT (either partial or full thickness tear) and 30 control volunteers were enrolled in this study. Their shoulders were imaged by MRI. The acromial shapes were classified into type I (flat), type II (curved), type III (hooked) and type IV (convex). Additional measurements including acromial thickness, acromio-humeral distance (AHD), acromial index (AI) and lateral acromial angle (LAA) were performed for further assessment.

Results: Type-II was the most commonly encountered acromial shape in both patients with RCT (44.6%) and control group (43.3%) with no significant difference in the incidence of each acromial shape between the two groups ($P > 0.05$). The acromial thickness, AHD, AI and LAA were significantly different in patients with RCT compared to control group ($P < 0.001$). Full thickness tear was significantly associated with type-III ($P < 0.05$).

Conclusion: Type-III acromion (hooked shaped) could be a risk factor for full thickness RCT.

1. Introduction

The acromion is a posterior shoulder landmark, formed as a posterolateral extension of the scapular spine, superior to the glenoid. It articulates with the clavicle and is the origin of the deltoid and trapezius muscles (1). Variation in the shape of the acromion can endorse variety of pathologies such as impingement syndrome and rotator cuff tear (RCT) (2). Rotator cuff disorder is one of the most common disorders of the shoulder. It is a common cause of chronic shoulder pain in adults. The specific etiology of a RCT has not been fully

Abbreviations: RCT, rotator cuff tear; AHD, acromio-humeral distance; AI, acromial index; LAA, lateral acromial angle.

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elucidated, but it has been considered to result from a combination of intrinsic and extrinsic factors. Intrinsic factors include degenerative changes, hypovascularity, and microstructural collagen fiber abnormalities. Recognized extrinsic factors include subacromial impingement, tensile overload and repetitive use (3).

The pathogenesis of RCT seems to be related to the morphology of the acromion which is usually assessed through the five commonly used parameters on standard plain radiographs including the acromial type, acromial slope, acromial tilt, lateral acromial angle and acromial index (4). However, with only a plain radiograph of the acromion in the supraspinatus outlet view, it is notoriously difficult to image the acromion and distinguish the hooked from the non-hooked acromion with anterior spurs (5,6).

The magnetic resonance imaging (MRI) makes it possible to depict the shape of acromion in its longitudinal axis with better evaluation of the acromial morphological factors including the acromial shape, acromial thickness, acromio-humeral distance, and lateral acromial angle and acromial index. These factors are suggested to influence the status of the rotator cuff (7,8). The acromial shape can be classified into four types: type I (flat), type II (curved), type III (hooked) (4–6) and type IV (convex) (Fig. 1) (7).

The aim of this study is to identify the morphological characteristics of the acromion associated with RCT using MRI and also, to recognize which type of the acromion could be risk factor for full thickness RCT.

2. Materials and methods

This study was carried out in the period from January 2011 to August 2012 in the Radiology department of our institution and included 56 patients with RCT either partial or full thickness (patients group). The exclusion criteria included previous surgery, fractures and/or dislocation, infections or tumors of the shoulder and cases with acromial spurs. All patients were imaged by MRI according to their side of complaint. Patients with bilateral RCT ($n = 6$) were stepped aside due to bilateral traumatic injury of both shoulders in 3 patients, bilateral acromial spurs in 2 patients and bilateral previous surgery in one patient. In order to study the incidence of each acromial shape, age- and sex-matched 30 asymptomatic volunteers without RCT were included as the control group. An official permission to carry out the study was obtained from the local medical research ethics committee. Written informed consent was obtained from all study participants.

2.1. Imaging procedures

All MRI images of our study were performed by using 1.5-Tesla unit system (Signa Horizon SR 120; General Electric Medical Systems, Milwaukee, WI, USA). A dedicated shoulder array coil was used. When imaging the shoulder with MRI, patients were placed in a supine position with their arms on the sides of the body in partial external rotation. Initially, the localizer images were obtained, followed by coronal oblique, sagittal oblique and axial images. The coronal oblique plane was selected parallel to the course of the supraspinatus tendon itself for optimal visualization of the tendon. The used MRI sequences and parameters were tabulated in Table 1.

Types of the acromion were evaluated in the T2 weighted (T2WI) sagittal oblique images. This sagittal oblique plane was parallel to the glenoid surface with selection of the images obtained just lateral to the acromioclavicular joint. Acromial morphology was classified into four types: type-I (flat), type-II (curved), and type-III (hooked) and type-IV (convex or upturned) (Fig. 1) (7–10).

The obtained images were retrieved from our institutional picture archiving and communication system (Millenmed Company, FDA approved for PACS) and assessment of the acromial type at parasagittal MR images was achieved mathematically by using the mathematical classification scheme for MR images, where a line connecting the most caudal margins of the acromial undersurface was manually drawn and its length was measured. This line was then divided with the help of two orthogonal lines, into three segments of equal lengths. Then, the angle between the anterior third and the posterior two thirds of the acromion was measured. If this angle was of 10° or less, type I acromion was considered. If it was between 11° and 20°, type II acromion was recognized. If this angle was more than 20°, then the angle between the posterior third and the anterior two thirds was furtherly measured. If this latter angle was 10° or less, type III acromion was defined and if more than 10° this would be type IV acromial shape (Fig. 2) (11). Acromial thickness was also measured at the widest portion of the acromion on the perpendicular plane to the

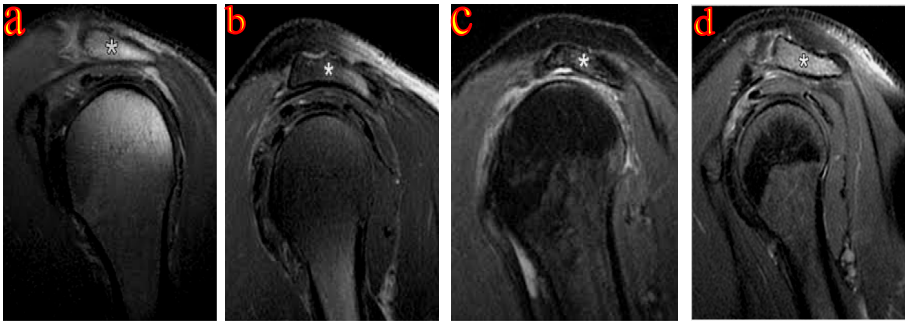

Fig. 1 *Types of acromial shape*. Type-I or flat type (a), type-II or curved type (b), type-III or hooked type (c) and type-IV acromion shape or convextype (d) (Quoted from Morag, et al. (7)).