Skeletal Radiol (1997) 26:31–34

ARTICLE

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Os acromiale: evaluation of markers for identification on sagittal and coronal oblique MR images

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Abstract An os acromiale is a developmental abnormality of ossification involving the anterior acromion which may contribute to impingement and rotator cuff disease. When axial MR sections do not include the acromioclavicular joint, the diagnosis of this often subtle abnormality will rest on its recognition on oblique coronal and sagittal images where it mimics the acromioclavicular joint. The identification of this anomaly is important as it frequently alters the type of surgical procedure utilized in symptomatic patients. We evaluate several imaging features which may be used to diagnose an os acromiale in these cases.

Key words Os acromiale · Shoulder impingement syndrome · Coracoacromial ligament · MRI

Introduction

MR imaging is an examination frequently used in the evaluation of shoulder disorders. The multiplanar capability, excellent contrast resolution, and noninvasive features of this imaging modality have promoted its use in the evaluation of patients with atypical or refractory shoulder pain. A variety of morphologic abnormalities involving the structures comprising the coracoacromial arch and acromioclavicular (AC) joint have been associated with impingement syndrome. An os acromiale is a developmental abnormality of ossification involving the anterior acromion and may contribute to impingement and rotator cuff disorder [1–4].

A recent retrospective study has described the different types and MR appearances of the os acromiale [5]. The axial plane is best for identification of these unfused ossification centers. However, axial sections frequently are not employed cephalad enough to include the acromion and AC joint. Diagnosis in these cases will rest on a recognition of this often subtle abnormality on oblique coronal and sagittal images, where it may mimic the AC joint. We have evaluated several imaging features which may be used to diagnose an os acromiale in these cases.

Materials and methods

Retrospective review of 11 MR examinations of the shoulder was performed in patients with os acromiale. The patients ranged in age from 33 to 65 years and presented with shoulder pain and functional disability. MR imaging was performed with a 1.5-T superconducting system with a dedicated shoulder receive coil. Dual echo conventional spin-echo sequences (2500/min, 70) were performed in the axial, oblique sagittal, and oblique coronal planes in all patients.

Examinations were reviewed by three musculoskeletal radiologists to determine: (a) the location of acromial nonfusion and hence type of os acromiale, (b) the appearance of the nonfusion site in the oblique sagittal and oblique coronal planes, (c) the loca-

tion of the os acromiale–acromion fusion defect on the oblique sagittal images with respect to a vertical line bisecting the humeral head, (d) the frequency of visualization and course of the coracoacromial ligament and its relationship with the unfused ossification center, and (e) secondary signs of the presence of os acromiale. A "double joint" appearance refers to the presence of both the clavicular–os acromiale joint (AC joint) and os acromiale–acromion nonfusion site on a single image. A line was constructed bisecting the humeral head on the last or next to last sagittal oblique image where a joint (presumably the AC or pseudo-AC joint) was identified. A positive "line sign" was recorded when this joint was located posterior to the line. Secondary signs of the presence of os acromiale included hypertrophic spurring and bone marrow edema at the margins of the nonfusion site.

Results

Os acromiale may be of seven different types based on the location of the unfused ossification center(s) [2]. In our series of 11 patients, ten were type A (representing a failure of meso-acromion and meta-acromion fusion) and one was type B (representing a failure of preacromion and mesoacromion fusion). The fusion defect was characterized by a low signal gap interrupting the normally high signal marrow of the distal acromion on T1-weighted and spin-density weighted sequences (Fig. 1). In seven patients, persistent low signal intensity was identified on T2-weighted images, with the remaining four patients evenly divided between those who had intermediate or high signal intensity within the gap. The os acromiale was best identified on axial images in all cases in which it was included. This plane also allows the most accurate characterization of the nonfusion site (Fig. 1).

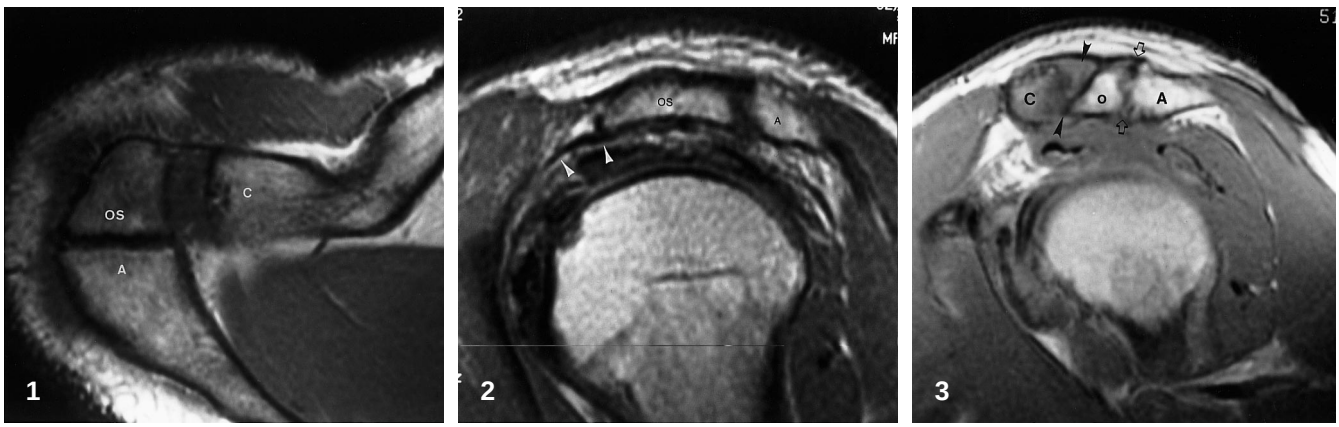
Oblique sagittal images allowed detection of the os acromiale in all cases. The coracoacromial (CA) ligament was well visualized in all studies and was most useful in distinguishing an os acromiale in this plane. The CA ligament could always be identified inserting along the anteroinferior border of the os acromiale, permitting the differentiation between a true AC joint and a "pseudo-AC joint" (Fig. 2). A "double joint" appearance was seen in only two examinations (Fig. 3). In the absence of a "double joint" sign it was often difficult to identify the os acromiale on oblique sagittal images as the osseous gap between unfused ossicle and remaining acromion frequently appeared similar to the AC articulation. The former "pseudo-AC joint" was posteriorly located with respect to a line bisecting the humeral head in seven patients (Fig. 4). In four patients overlap with normal AC joint location existed using this sign (Fig. 5). Secondary signs were present in a minority of patients (four) and were helpful in the recognition of an os acromiale as they focused attention on this anatomic region. Two patients had bone marrow edema within the accessory os and acromial remnant, while two had prominent osteophytic spurring about the fusion defect.

The oblique coronal plane was least useful in demonstration of the osseous nonfusion site, with poor characterization of this defect in seven cases. No "double joint" appearance was seen in this plane. The CA ligament was incompletely visualized on coronal oblique images in seven patients, limiting its utility in the evaluation of acromial nonfusion defects. When present, hypertrophic spurring and marrow edema remained helpful as secondary signs of the presence of os acromiale.

Fig. 1 Axial spin-density (2500/16) weighted image demonstrates linear low signal at the interface of the meso-acromion and meta-acromion of an os acromiale. *OS* os acromiale, *A* acromion, *C* clavicle

Fig. 2 Oblique sagittal spin-density (2500/16) weighted image demonstrates the insertion of the coracoacromial ligament onto the anteroinferior margin of the os acromiale (*arrowheads*). *OS* os acromiale, *A* acromion

Fig. 3 Oblique sagittal spin-density (2500/16) weighted image demonstrates the "double joint" appearance. Note the hypertrophic spurring present. *C* clavicle, *o* os acromiale, *A* acromion, *open arrows* os acromiale–acromion nonfusion site, *arrowheads* os acromiale–clavicular joint



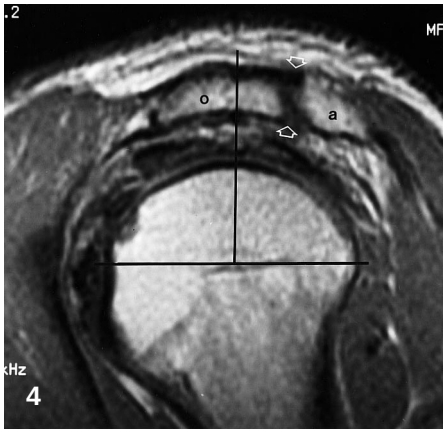


Fig. 4 Oblique sagittal spin-density (2500/16) weighted image demonstrates a positive humeral line sign. The "pseudo-AC joint" (*open arrows*) is located posterior to a vertical line which bisects the humeral head. *o* os acromiale, *a* acromion

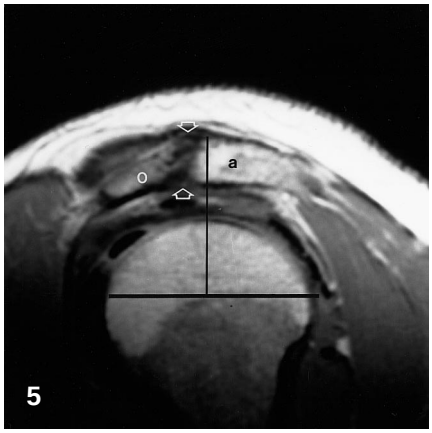


Fig. 5 Oblique sagittal spin-density (2500/16) weighted image demonstrates a negative humeral line sign. The "pseudo-AC joint" (*open arrows*) is located at or anterior to a vertical line which bisects the humeral head. *o* os acromiale, *a* acromion

Discussion

Os acromiale results from a failure of fusion at any of three separate acromial ossification centers. This developmental anomaly has been reported to have an incidence between 1.4% and 8.4% and to be bilateral in up to 62% of cases [1, 4, 6]. Seven possible types have been described, with a failure of meso-acromial and meta-acromial fusion being most common [1, 5]. MR examination of the shoulder may accurately characterize this abnormality and delineate associated rotator cuff pathology and hypertrophic changes that may contribute to mechanical impingement [5]. A previous retrospective study noted that the axial plane is best for identification of os acromiale, however, this imaging plane is frequently not implemented cephalad enough to include the AC joint. In some of these cases an os acromiale may be very difficult to identify as it frequently mimics the AC joint. Among surgical patients with symptoms of impingement or rotator cuff tear, the identification of an os acromiale may have significant implications for surgical planning . Arthroscopic subacromial decompression may not be indicated and several procedures ranging from os acromiale excision to ossicle fusion have been recommended [1, 4].

Our experience also indicates that the os acromiale is most easily identified in the axial plane. However, when these images are not available, other signs must be used to identify this abnormal structure. A "double joint" appearance representing the junction of the os acromiale with the acromion posteriorly and the clavicle anteriorly is a helpful finding previously described on oblique sagittal images [5]. However, this appearance was present in only 18% (2/11) of our cases.

The "pseudo-AC joint" was often noted to lie in a more posterior location than that expected for the true AC joint on oblique sagittal images, using the vertical line sign (7/11, 64%) (Fig. 5). Some apparent overlap with normal AC joint location using this sign may be due to variability in prescription of the sagittal oblique imaging plane. In addition, the infrequent os acromiale resulting from nonfusion at its anteriormost ossification center might be expected to be missed using this sign, as it was in one patient in this series with such a defect. While a positive vertical humeral line sign was somewhat insensitive in this study, it was helpful in identification of fusion defects when present.

The CA ligament extends from the lateral base of the coracoid process to the anteroinferior margin of the acromion. As there is no clavicular insertion, this anatomic point was most useful in distinguishing a "pseudo-AC joint" from the true AC joint. In questionable cases, a ligament seen to insert on the anterior osseous structure identifies an unfused os and not the distal clavicle. The CA ligament could be identified on sagittal oblique images in all cases, and in the absence of axial images provided the most confirmatory evidence of the presence of os acromiale (11/11, 100%).

Identification of the os acromiale was frequently difficult on oblique coronal images using any sign. This was probably due in part to the nearly parallel orientation of the imaging plane with these fusion defects.

The os acromiale may be united to the remainder of the acromion by periosteum, cartilage, synovium, or fibrous tissue [2, 5, 6]. This probably accounts for the variability of signal intensity present at the nonfusion site on T2-weighted images. Synovial or cartilaginous interfaces might be expected to exhibit increased signal intensity on this sequence, while fibrous tissue would be expected to be of low signal intensity on both T1- and T2-weighted images. This relationship between the os and acromial remnant may have other implications as well. Increased mobility of the os acromiale probably leads to degenerative spurring at the fusion defect and bone marrow edema. Inferior displacement of the os during deltoid contraction is thought to narrow the subacromial space resulting in impingement and ultimately rotator cuff tear. Secondary signs were present in a minority

of patients (4/11, 36%). While insensitive and somewhat nonspecific as signs, the presence of spurring or edema was helpful in identification of os acromiale as it focused more scrutiny on this anatomic region.

In summary, sagittal oblique images are more useful than coronal oblique images for detection of os acromiale. Correct identification is more reliably achieved by noting the CA ligament insertion site rather than the "double joint" sign previously described. A positive "vertical humeral line" sign, hypertrophic spurring, or bone marrow edema are helpful, though insensitive, indicators of the presence of os acromiale.

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