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*Original Article*

# Prevalence of os acromiale and concomitant rotator cuff tears: a focused assessment of 3697 shoulder magnetic resonance imagings

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ABSTRACT

***Objective:*** The purpose of this study was to define the prevalence of os acromiale on magnetic resonance imaging (MRI) in patients presenting with shoulder pain, to document how often it coexists with rotator cuff tears, and to assess whether focused review detects this variant more reliably than routine radiology reporting.

***Methods:*** A retrospective review was conducted on 3697 shoulder MRI examinations obtained between 2020 and 2025 at a tertiary referral center. All studies were independently evaluated by 2 fellowship-trained shoulder surgeons and 1 musculoskeletal radiologist, focusing specifically on the presence, subtype, and coexistence of os acromiale with rotator cuff pathology. Interobserver reliability was assessed using Cohen's kappa coefficient, and findings were compared with the original radiology reports.

***Results:*** Os acromiale was identified in 26 cases, corresponding to a prevalence of 0.7%. Only 11 cases were mentioned in the original radiology reports. Interobserver agreement between shoulder surgeons was almost perfect (κ=0.98) and excellent between surgeons and the radiologist (κ=0.92). Subtypes included 12 preacromion, 13 mesoacromion, and 1 metaacromion. Rotator cuff tears were present in 20 of 26 patients with os acromiale (77%), including isolated supraspinatus tears (n=9), combined supraspinatus–infraspinatus tears (n=4), supraspinatus–subscapularis tears (n=3), massive tears (n=2), and cuff tear arthropathy (n=2).

***Conclusion:*** Os acromiale was uncommon in this MRI-based cohort but frequently coexisted with full-thickness rotator cuff tears. Although causality cannot be inferred, this coexistence may carry clinical relevance. Notably, focused evaluation documented more cases than routine radiology reports, underscoring the added value of targeted assessment.

***Level of Evidence:*** Level IV, Diagnostic study.

## Introduction

An os acromiale is a developmental anomaly of the acromion resulting from incomplete fusion of its ossification centers, leaving a persistent fibrocartilaginous junction. First described by Gruber in 1863, the acromion develops from 4 secondary ossification centers, namely the preacromion, mesoacromion, metaacromion, and basiacromion, any of which may fail to unite. These centers usually appear between 15 and 18 years of age and normally fuse with the basiacromion between 22 and 25 years.[1,2,3] When this fusion process is interrupted, 3 distinct types of os acromiale can be identified: preacromion, mesoacromion, and metaacromion, with the mesoacromion being the most common.[4,5,6,7]

Although often asymptomatic and discovered incidentally on imaging, an os acromiale may present with pain localized to the anterolateral acromion, aggravated by overhead activity or at night.[7] Clinical findings frequently overlap with subacromial impingement or acromioclavicular joint arthrosis, making it difficult to attribute symptoms solely to this anomaly.[4,8] Nevertheless, os acromiale may lead to a dynamic type of outlet-based impingement which is an extrinsic factor in the etiology of rotator cuff tears, with several studies reporting a higher incidence of cuff pathology in affected shoulders.[6,9,10,11]

Reported prevalence varies significantly depending on study design, with values in the literature ranging between 1 and 15 percent.[12,13] Magnetic resonance imaging (MRI)–based series generally demonstrate lower frequencies, while radiographic studies may misinterpret variants, and anatomical studies tend to report the highest rates, partly due to postmortem artifacts and demographic biases.[14,15,16] Differences in interpretation between radiologists and orthopedic surgeons may also contribute to variability.

This study sought to document the prevalence of os acromiale in a large MRI-based symptomatic population, to evaluate how reliably it is recognized in routine reporting, and to investigate its coexistence with rotator cuff tears. It was hypothesized that os acromiale would be uncommon yet show a notable rate of coexistence with full-thickness tears and that focused evaluation would enhance identification.

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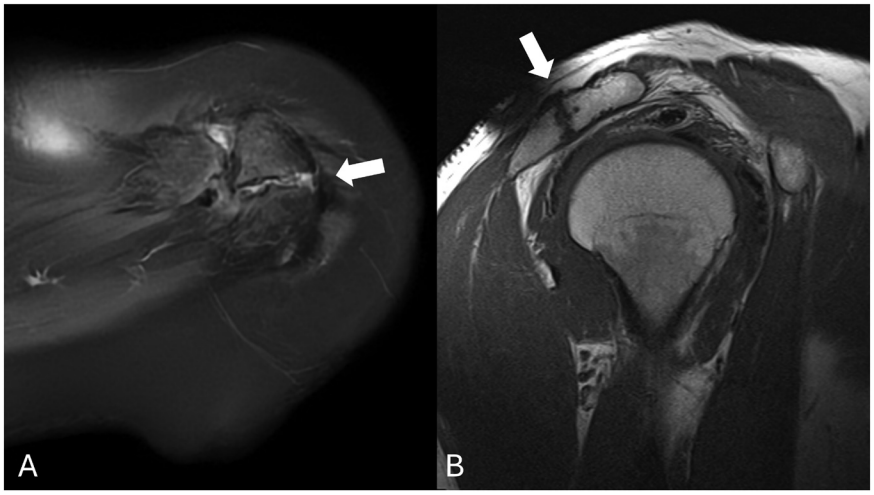


**Figure 1.** Os acromiale visualized on T2-weighted axial (A) and T1-weighted sagittal oblique (B) MR images. The unfused ossification center (white arrow) creates a double acromioclavicular joint appearance characteristic of os acromiale.

## Material and methods

This retrospective observational study was conducted at a tertiary referral center. Ethical committee approval was obtained from the Koç University Institutional Review Board (IRB No. 2025.453.IRB2.207), and all patients had previously signed a standardized institutional consent form, which authorizes the use of anonymized clinical and imaging data for research. All consecutive shoulder MRI examinations performed for persistent, nontraumatic shoulder pain between June 2020 and June 2025 were screened. A total of 3775 shoulder MRI examinations were identified. Because complete union of the acromial ossification centers may occur as late as 20 years of age, 45 patients younger than 20 were excluded unless unequivocal fusion of all apophyses was visible.[12,17] Thirty-three studies were excluded due to poor image quality or incomplete imaging planes, leaving 3697 for final analysis. For differentiation of a true os acromiale from an unfused apophysis, interface morphology and orientation were evaluated. A transverse interface with irregular margins was defined as os acromiale, whereas an arched interface with smooth or lobulated margins was considered a normal developmental variant.[1,5,23]

The MRI examinations were performed using a 1.5-Tesla MRI scanner (Magnetom Aera; Siemens, Erlangen, Germany), equipped with a phased array shoulder coil. Patients were scanned in a supine position. The MRI protocol included coronal, sagittal, and axial proton density–weighted images, as well as coronal and sagittal T1-weighted sequences (Figure 1). Original radiology reports were generated by multiple attending radiologists in routine clinical practice.

**HIGHLIGHTS**

- The prevalence of os acromiale on shoulder magnetic resonance imagings (MRI) was 0.7%, substantially lower than historically reported in anatomical or radiographic studies.
- Focused MRI evaluation identified all os acromiale cases, whereas more than half were overlooked in routine radiology reports, emphasizing the value of targeted assessment.
- Rotator cuff tears were present in 77% of patients with os acromiale, supporting a probable mechanical association between these 2 conditions.
- Enhanced communication between clinicians and radiologists, including relevant clinical information, may further improve recognition of this underreported anatomical variation.

Each MRI was independently evaluated by 2 fellowship-trained shoulder surgeons and 1 musculoskeletal radiologist, all with more than 10 years of experience. Discrepancies were resolved by open discussion to reach a consensus. Findings from this focused assessment were compared with the original radiological reports issued at the time of imaging to evaluate potential differences between routine radiological reporting and targeted assessment.

The presence and subtype of os acromiale were recorded. Os acromiale types were classified according to the anatomical description by Winfeld et al,[5] defining the preacromion at the coracoacromial ligament and anterior deltoid insertion, the mesoacromion at the middle deltoid insertion, and the metacromion at the posterolateral segment corresponding to the posterior deltoid insertion. In patients with consensus diagnosis of os acromiale, concomitant rotator cuff pathology was documented, including tear size and its location. Tear size was defined as the extent of tendon involvement on MRI rather than linear measurements. Tear extent was categorized using the Collin classification based on involvement of the rotator cuff tendons. All patients with os acromiale in this cohort presented with atraumatic shoulder pain; none demonstrated instability, dislocation, or trauma-related symptoms. Therefore, subgroup analyses based on specific presenting complaints were not applicable.

Statistical analyses were performed using SPSS version 28.0 (IBM, New York, USA). Descriptive statistics were used to calculate the prevalence of os acromiale and summarize patient demographics. Interobserver reliability was assessed using Cohen's kappa. Agreement was first calculated between the 2 orthopedic surgeons, and then between the surgeons' consensus and the musculoskeletal radiologist.

## Results

Among the 3697 shoulder MRI examinations performed for patients with shoulder pain, 26 cases of os acromiale were identified, corresponding to a prevalence of 0.7% within this symptomatic cohort. Age and sex distributions were comparable between patients with and without os acromiale (os acromiale group: mean age 64.6 years, 10 females and 16 males; remaining cohort: mean age 53.6 years, 52% female). Only 11 of these cases had been noted in the original

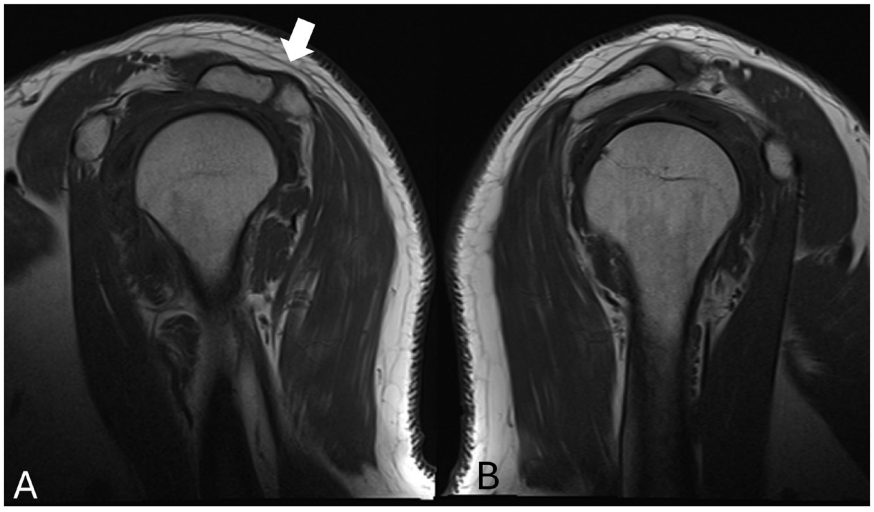


**Figure 2.** Bilateral sagittal oblique MR images of a 48-year-old male patient showing unilateral os acromiale. The unfused ossification center is indicated by the white arrow.

radiology reports, whereas focused reassessment by the musculoskeletal radiologist identified all 26. In 4 cases there was initial disagreement between the orthopedic surgeons and the radiologist, which was resolved by consensus; the surgeons were correct in 2 instances and the radiologist in the remaining 2. Interobserver agreement between the 2 orthopedic surgeons was almost perfect ($\kappa=0.98$). Agreement between the surgeon consensus and the musculoskeletal radiologist was likewise excellent ($\kappa=0.92$), corresponding to 99.9% overall concordance.

Regarding subtype distribution, 12 os acromiale were classified as preacromion (46%), 13 as mesoacromion (50%), and 1 as metaacromion (4%). Among the 26 patients with os acromiale, bilateral shoulder MRIs were available in 6. Of these, 1 patient demonstrated bilateral os acromiale and the remaining 5 showed unilateral involvement (Figure 2).

Rotator cuff pathology was identified in 20 of 26 patients with os acromiale (77%). Among these, 9 (45%) had isolated supraspinatus tears, 4 (20%) had combined supraspinatus and infraspinatus tears (Collin type D), and 3 (15%) had supraspinatus and subscapularis tears (type A)[18] (Figure 3). Two cases (10%) were classified as massive rotator cuff tears (Collin type C), and 2 (10%) as cuff tear arthropathy. The 2 cuff tear arthropathy cases demonstrated advanced changes on MRI, and 4-view radiographs confirmed Hamada stage 4B. Partial-thickness tears and isolated tendinosis were not included in the analysis, as these findings may represent early or nonspecific degenerative changes rather than clinically significant cuff pathology. Notably, no partial-thickness tears were identified in patients with os acromiale.

## Discussion

A focused evaluation of 3697 shoulder MR images demonstrated that os acromiale is much less frequent than previously reported, with a prevalence of 0.7 percent. It was also found that it is often missed in routine radiology reports and observed a high rate of associated rotator cuff tears, particularly in younger patients.

Anatomical studies have often reported higher frequencies of os acromiale compared with radiological series, and anthropological investigations have similarly noted prevalences as high as 30%.[16,17] Several factors may account for this discrepancy. Aging and degenerative changes in cadaveric specimens can mimic nonunion, and unrecognized trauma may be misinterpreted as a developmental defect. Additionally, some early anatomical collections included related individuals, suggesting a potential hereditary component, and may have been subject to sampling bias rather than representing true population prevalence.[12,14,19,20]

In radiological studies, the axillary lateral radiograph has been considered the most reliable plain film view for identifying an os acromiale, whereas anteroposterior and scapular Y-views frequently miss the finding.[21] However, radiographic diagnosis is highly dependent on projection angle and image quality, and both underreporting and overreporting may occur due to superposition and artifacts. The reported prevalence of os acromiale decreases with the use of more advanced imaging techniques, largely because MRI provides clearer differentiation between a true nonunion and normal apophyseal

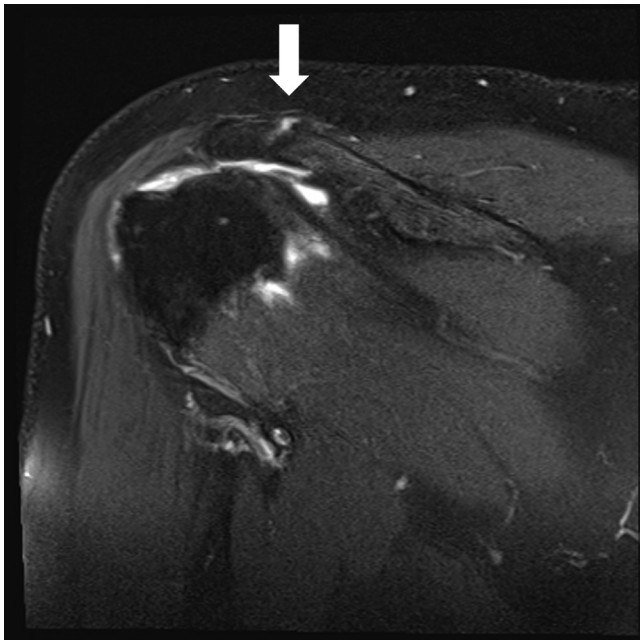

**Figure 3.** T2-weighted coronal images of a 56-year-old patient with concomitant os acromiale and rotator cuff tear. The infraspinatus tendon is torn and retracted at the level of the os acromiale (white arrow).

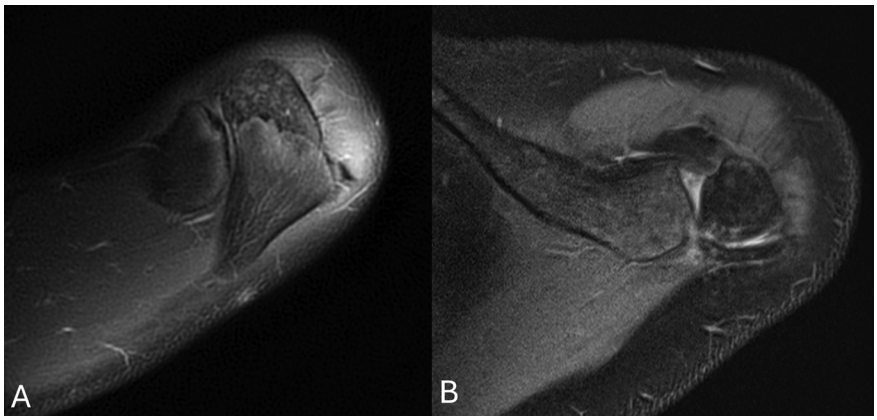


**Figure 4.** Differentiation between an unfused apophysis (A) and a true os acromiale (B). A transverse interface with irregular margins indicates os acromiale, whereas an arched interface with smooth or lobulated margins represents a normal developmental variant.

variants.[12,15,22] The prevalence of 0.7% is consistent with the MRI-based prevalence reported by Kumar et al (0.7%),[12] further supporting the notion that advanced imaging modalities yield lower and more accurate estimates than radiographic or anatomical studies. Despite evaluating a symptomatic population, the prevalence of os acromiale in the cohort remained low. This finding is not unexpected, as os acromiale is a relatively uncommon anatomical variant and most patients presenting with shoulder pain have alternative explanations for their symptoms, such as rotator cuff disease, biceps tendonitis or acromioclavicular joint degeneration. Furthermore, the use of strict MRI-based criteria likely reduced false-positive identification by enabling clearer differentiation between a true os acromiale and normal apophyseal variants. These factors may account for the low prevalence observed in the symptomatic cohort.

With MRI, the accuracy of diagnosis further improves, allowing evaluation of the acromial interface in multiple planes and detection of secondary changes such as hypertrophic osteophyte formation, marrow edema, or associated pathologies including rotator cuff tears.[22,23,24] However, superior osteophytes, acromioclavicular joint degeneration, and vascular structures crossing the superior surface of the acromion may mimic an os acromiale. Os acromiale was observed to be best visualized on T2-weighted axial and T1-weighted sagittal oblique sequences, where it may appear as a double acromioclavicular joint appearance. The imaging plane should extend sufficiently cephalad to include the acromioclavicular joint.[3,23] In addition, the interface orientation on the axial plane should be carefully assessed to differentiate an arched and smooth normal apophysis from a transverse and irregular os acromiale, particularly in younger patients.[5,23] (Figure 4)

In this series, the preacromion subtype was almost as frequent as the mesoacromion, contrasting with earlier reports that described mesoacromion as the predominant form[14,21] (Figure 5). This discrepancy likely reflects both the limited ability of plain radiographs to visualize the anterior acromial margin and the tendency for small preacromial fragments to be lost or damaged in anatomical specimens, leading to underrecognition in previous studies. The MRI provides superior depiction of the acromial morphology in multiple planes, allowing more accurate identification and classification of os acromiale variants.[4,15,22]

The prevalence of rotator cuff tears among patients with os acromiale was 77% in the series (20/26), which is higher than previous studies.[14,21] This likely reflects the use of MRI, which provides a more accurate multiplanar assessment of both os acromiale and cuff pathology.[22,23] The literature shows mixed findings regarding the relationship between these entities. Earlier clinical studies suggested that motion at an unfused acromial fragment may predispose individuals to cuff degeneration, whereas more recent imaging-based studies did not consistently confirm this association. Mudge et al[25] were among the first to describe a potential dynamic mechanism, proposing that the anterior fragment may flex downward during deltoid contraction and arm elevation, narrowing the supraspinatus outlet. Accordingly, several authors recommend addressing a concomitant os acromiale when repairing a rotator cuff tear.[6,10,14,26-28] Yet some studies have

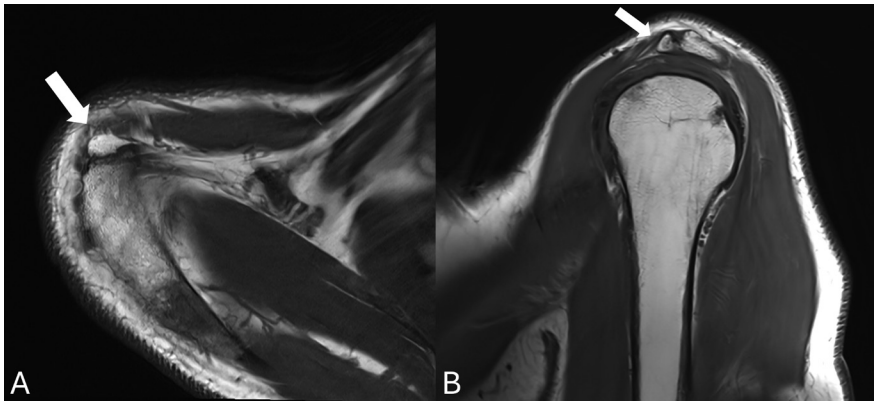


**Figure 5.** Preacromion visible on axial T1 (A) and sagittal oblique T1 (B) images. MRI provides superior visualization of small anterior acromial segments, allowing accurate identification of the preacromion subtype.

questioned this relationship.[12-14,29]. Boehm et al[21] found similar rates of os acromiale in patients with and without cuff tears, although their reliance on axillary radiographs and operative notes may have underestimated prevalence. Ouellette et al[29] reported comparable cuff tear rates between os acromiale (64%) and control (69%) groups, but their control cohort showed an unusually high tear incidence, suggesting selection bias. Likewise, Kumar et al,[12] despite reporting a 0.7% prevalence consistent with the findings, observed no correlation with rotator cuff tears in their MRI sub-analysis, though only 5 os acromiale cases were included and the overall tear rate of 57% again indicates referral bias. Roedl et al[30] reported significantly higher rotator cuff abnormalities in adolescents with acromial apophysiolysis who later developed os acromiale, although their population differs markedly from ours. Although causality cannot be established in this retrospective design, the exceptionally high coexistence rate observed aligns with earlier hypotheses proposing a mechanical link between os acromiale and rotator cuff pathology.

An important methodological aspect of this study was the focused evaluation of all shoulder MRIs specifically for the presence of os acromiale. Routine radiological reports primarily address structures relevant to the clinical indication, and developmental variants such as os acromiale may not always be documented unless deemed clinically significant. By systematically reexamining all studies with this targeted aim, the analysis revealed that os acromiale is often underreported in standard practice. This finding emphasizes the importance of structured MRI evaluation and effective communication between orthopedic surgeons and radiologists, as awareness of clinical details such as localized acromial tenderness or atraumatic rotator cuff tears in younger patients can direct attention to subtle but relevant anatomical variations such as os acromiale.[31-33]

This study has several limitations. All MRIs were obtained from patients presenting with shoulder pain, which limits the generalizability of the findings; the true prevalence in the general population, or in studies that include asymptomatic contralateral shoulders, would likely be lower. In addition, the retrospective design may have introduced selection bias, although all examinations were performed using standardized MRI protocols. Because the original radiology reports were produced by multiple radiologists, variability in reporting practices may have contributed to underrecognition of os acromiale. Finally, because the study lacks a control group and did not analyze rotator cuff tear prevalence in the non–os acromiale population, the observed coexistence should be interpreted as descriptive rather than evidence of a definitive association.

Os acromiale was identified in 0.7% of shoulder MRI examinations in this symptomatic cohort, significantly less frequent than previously reported. Focused evaluation detected substantially more cases than routine radiology reporting, underscoring the importance of targeted assessment for this variant. Concomitant rotator cuff tears were present in 77% of patients with os acromiale, indicating frequent coexistence; however, its clinical significance remains uncertain, and no statistical association can be established within the design of this study. Larger prospective studies are needed to further clarify its relevance and its relationship to rotator cuff disease.

**Data Availability Statement:** The data that support the findings of this study are available on request from the corresponding author.

**Ethics Committee Approval:** Ethical committee approval was received from the Koç University Ethics Committee (Approval no: 2025.453.IRB2.207, Date: 16.10.2025).

**Informed Consent:** Written informed consent was obtained from the patients who agreed to take part in the study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – O.B., C.G., İ.E.; Design – O.B., A.B., M.C.; Supervision – İ.E.; Resources – O.B.; Materials – A.B., M.C., G.T.Y.; Data Collection and/or Processing – O.B., İ.E., G.T.Y.; Analysis and/or Interpretation – O.B., İ.E.; Literature Search – M.C., A.B.; Writing – O.B., G.T.Y.; Critical Review – İ.E.

**Declaration of Interests:** İlker Eren is the Deputy Editor of Acta Orthopaedica et Traumatologica Turcica, however; his involvement in the peer-review process was solely as an author. The other authors have no conflict of interest to delcare.

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