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# How to discriminate between acute traumatic and chronic degenerative rotator cuff lesions: an analysis of specific criteria on radiography and magnetic resonance imaging

**Markus Loew, PhD[a], Petra Magosch, MD[a], Sven Lichtenberg, MD[a], Peter Habermeyer, PhD[b], Felix Porschke, MD[c,*]**

[a]*Department of Shoulder and Elbow Surgery, ATOS Clinic, Heidelberg, Germany*
[b]*Department of Shoulder and Elbow Surgery, ATOS Clinic, Munich, Germany*
[c]*BG Trauma Center Ludwigshafen at Heidelberg University Hospital, Ludwigshafen, Germany*

**Background:** Discrimination between acute traumatic and chronic degenerative rotator cuff lesions (RCLs) is an important aid to decision making in therapeutic management. To date, no clinical signs or radiologic findings that enable confident differentiation between these distinct etiologic entities have been identified. The purpose of this investigation was to perform a systematic analysis of known radiographic and magnetic resonance imaging (MRI) features of RCLs and of further, not yet accurately described parameters. The hypothesis was that there are specific radiologic features that allow reliable discrimination between traumatic and nontraumatic RCLs.

**Methods:** Fifty consecutive patients with RCLs confirmed by MRI were enrolled in this study. Group A was made up of 25 patients with a history of trauma within the previous 6 weeks and no pre-existing shoulder pain, whereas group B comprised 25 patients with shoulder pain for not more than 12 months and no history of relevant trauma. Radiographs and magnetic resonance images were analyzed in a standardized protocol.

**Results:** No radiographic features were found to differ significantly between the 2 groups. On MRI, edema in the injured muscle was more common in group A (37.5% vs 4%, $P = .04$). A characteristic feature in traumatic RCLs was a wavelike appearance (kinking) of the central tendon (64% vs 32%, $P = .03$). In group B, more muscular atrophy was found (29.2% vs 60%, $P = .02$). Thinning and retraction did not differ between the groups.

**Conclusion:** MRI, but not radiography, can be used to help discriminate between traumatic and nontraumatic RCLs. Although no absolute distinguishing feature was found, edema, kinking, and muscular atrophy are positive criteria for differentiation.

**Level of evidence:** Level II, Diagnostic Study.



**Keywords:** Rotator cuff tear; trauma; MRI; kinking; atrophy

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*Reprint requests: Felix Porschke, MD, BG Trauma Center Ludwigshafen at Heidelberg University Hospital, Ludwig-Guttmann-Straße 13, D-67071 Ludwigshafen, Germany.

E-mail address: felix.porschke@bgu-ludwigshafen.de (F. Porschke).

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Rotator cuff lesions (RCLs) can impair patients' quality of life and lead to secondary cuff tear arthropathy. In younger patients in particular, RCLs interfere with the function and loading capacity of the shoulder and thus with the ability to work.[29,33,52] In several investigations, autopsy, magnetic resonance imaging (MRI), and ultrasound analyses have shown an increasing incidence of RCLs with age.[31,48] There is consensus that most RCLs are the result of degenerative causes. Various extrinsic (outlet impingement) and intrinsic (blood supply) factors have been identified as causes.[35,50] Especially in elderly patients with chronic and nontraumatic RCLs, initial nonsurgical treatment is recommended.[20,21]

In contrast, it remains controversial whether any rotator cuff tears are caused exclusively by trauma without any pre-existing degenerative impairment of the tendons. In patients aged younger than 40 years, normally only a high-force injury (eg, causing a shoulder dislocation) suffices to tear the tendons of the rotator cuff.[39] In elderly persons, however, trauma is frequently held responsible for the tendon defect. In those cases, the question of whether the trauma was truly responsible for the tendon rupture or whether the patient already had an asymptomatic RCL regularly arises. In addition, there is the possibility that trauma worsens or reveals a pre-existing asymptomatic RCL (acute-on-chronic tear). Conservative treatment should also be considered in such cases.

Early surgical treatment is recommended in most cases of traumatic RCLs.[3,17,38] The outcome of rotator cuff repair is better in traumatic than in degenerative RCLs.[7,22] In many cases, a complete traumatic RCL tends to retract rapidly because of the high elasticity of the tendon tissue, which disappears with time because of remodeling and fibrosis.[13,17] Therefore, reliable differentiation between acute traumatic RCLs and chronic degenerative RCLs has a high impact on therapeutic decision making. A careful survey of the patient's medical history is able to distinguish between a solely traumatic and a purely degenerative RCL. However, for the common situation in which an acute-on-chronic RCL mimics a pure traumatic RCL, the patient history alone is insufficient for differentiation. Defining parameters that characterize traumatic and degenerative RCLs could be of assistance.

Surprisingly, there are almost no evidence-based data that facilitate discrimination between traumatic and non-traumatic RCLs. A previous study by our group, focusing on the analysis of clinical diagnostics, showed that physical examination, together with established clinical tests, can indicate the cause and likely time of occurrence of an RCL.[26] Certain radiologic parameters may also discriminate between the 2 etiologic entities.

The purpose of this study was to analyze radiographs and MRI scans of patients regarding established or new radiologic parameters enabling differentiation between acute traumatic RCLs and chronic degenerative RCLs. The hypothesis was that there are features that allow reliable discrimination.

## Methods

Between 2011 and 2013, 50 patients with MRI-proven RCLs were enrolled prospectively. All patients underwent surgery because of their symptoms and disabilities. All patients gave their written consent to the analysis and publication of their anonymized data.

Group A comprised 25 consecutive patients who underwent a shoulder injury with no history of problems with the involved joint. Trauma was defined as a sudden, unexpected external event determined by date and place. Only falls from standing height or greater onto the abducted outstretched arm were classified as trauma. Cases of simple contusions, a direct force on the shoulder (eg, falling on the adducted arm), and distortion during active weight lifting were excluded. Of the 25 patients in group A, 16 had fallen onto the outstretched arm from standing position; 3 reported a fall from greater than standing height; and 6 had been involved in high-velocity bicycle, motorcycle, or skiing accidents. In 2 patients, glenohumeral dislocation resulted.

Group B consisted of 25 consecutive patients with shoulder symptoms for no more than 12 months who were not aware of any trauma on the involved side (Table I). All patients had undergone MRI no more than 6 weeks before enrollment. The exclusion criteria were as follows: age older than 65 years, neurologic disease involving the arm, previous surgery on the affected shoulder, known RCL of the contralateral shoulder, any radiologic signs of shoulder arthritis exceeding grade 1 according to Samilson and Prieto,[40] and cuff tear arthropathy of grade I or more according to Hamada et al[15] on either side.

In all patients, standardized radiographs were obtained in the true anteroposterior view in neutral rotation and in the axillary and supraspinatus (SSP) outlet views. The radiographs were analyzed for the following: presentation of degenerative features such as cortical thickening, subcortical sclerosis, and cyst-like lesions at the major tuberosity; acromiohumeral distance; and sclerosis and cortical thickening at the undersurface of the acromion. Furthermore, the form of the acromion was documented using the classification of Bigliani et al,[4] and any signs of advanced arthritis of the acromioclavicular joint were recorded.

All patients had undergone MRI of the involved shoulder no more than 6 weeks before enrollment in the study. In most cases, MRI had been performed elsewhere. The minimum requirement for MRI was the availability of images in all 3 planes (coronal oblique, sagittal oblique, and axial) with T1, T2, and fast spin echo fat-saturated sequences. In the trauma group, most patients underwent MRI soon after trauma (median, 7 days after injury; range, 1-36 days).

Analysis of the images included the following: number and topography of injured tendons, degree of retraction according to the classification of Patte,[36] configuration of the proximal tendon stump, atrophy or fatty infiltration of the involved muscles,[45,51] distinctive effusion in the glenohumeral joint or in the subacromial bursa (or both), and presence of subcortical signal enhancement in the humeral head (bone bruise) (Table II). All radiographs and magnetic resonance images were analyzed by 2 blinded authors with expertise in shoulder surgery (M.L. and F.P.).

Descriptive statistics and invariant data analysis were performed using IBM SPSS Statistics, version 20.0.0 (IBM, Armonk, NY, USA). Categorical variables were analyzed using contingence tables and the $\chi^2$ test, and metrical data were analyzed with the *t*