Tears at the rotator cuff footprints: imaging characteristic on MRI and ultrasound, evolutions and clinical significance

Poster No.: C-0521
Congress: ECR 2012
Type: Scientific Paper
Authors: S. Martin Martin, J. M. Rapariz, M. Pico, M. A. Garcia, C. Martinez; Palma de Mallorca/ES
Keywords: Musculoskeletal joint, MR
DOI: 10.1594/ecr2012/C-0521

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

PURPOSE:

To describe the imaging characteristics on magnetic resonance imaging (MRI) of tears at the rotator cuff footprint.

Methods and Materials

MATERIALS AND METHODS:

PATIENTS:

This study was performed with approval from our institutional review board.

From February 15, 2009, to April 24, 2011, a total of 984 MR images of the shoulder were taken at our institution. Inclusion criteria were the performance of a standardized MRI protocol.

Two radiologists, in consensus, who had 2 and 10 years of experience in musculoskeletal radiology, retrospectively reviewed all 984 MR images in order to identify rotator cuff injuries at the level of its distal insertion on the footprint. Of these 984 MR images, a total of 81 showed tears at the rotator cuff footprint. Therefore, MR images of 81 consecutive patients were included in this study, consisting of 45 female and 36 male patients with a mean age of 58 years.

MR IMAGES:

All MR images were taken using a 1.5T MR system (General Electric Sygma Medical Systems) and a dedicated shoulder coil (MRI USAI PA Shoulder). The MR examinations were performed with the shoulder in the neutral position. Proton density-weighted images (TR/TE, 2400-2500 ms/34) with fat suppression were acquired in the coronal oblique plane and the transverse plane. T2-Weighted fast spin-echo images (TR/TE 2800-4000 ms, 40-85 ms) were obtained in the coronal oblique plane and sagittal oblique plane. T1-Weighted fast spin-echo images (TR/TE, 650 ms/min full) were obtained in the transverse plane. The parameters for all sequences were a section thickness of 4 mm with an intersection gap of 0.4 mm and a field of view of 18. In some cases, a MR arthrograms were performed.

The cuff injuries were classified into four groups (Fig. 1):
1. Partial articular-side supraespinatus tendon avulsion (PASTA) lesions were diagnosed if there was a discontinuity of the undersurface tendon fibres into the tendon from the articular side (Fig. 1a).

2. Concealed interstitial delamination (CID) lesions were diagnosed if there was focal high signal intensity on T2-weighted images (Fig. 1b).

3. Bursal-side tendon avulsion (reverse PASTA) lesions were diagnosed if there were tendon lesions continuous to the subdeltoid bursa (Fig. 1c).

4. Full-thickness tear lesions were diagnosed if the lesions extended through the entire articular-to-bursal thickness of the tendon (Fig. 1d).

The anatomical location was determined using three different categories: 1. supraspinatus - anterior half of the greater tuberosity; 2. transition zone - superior facet of the greater tuberosity; 3. infraspinatus - posterior half of the greater tuberosity.

**REVIEW OF THE CLINICAL DATA:**

The same orthopaedic surgeons retrospectively reviewed the clinical records of these 81 patients. A Constant Score was obtained in 32 patients. The patients were classified into four groups: O: Severe pain; 5: Moderate pain; 10: Mild pain and 15: No pain. An ultrasound evaluation was later performed in 25 patients between 1 day and 2 years and 3 months since the MR imaging. A total of 10 patients were operated.

**Images for this section:**
**Fig. 1:** FIGURE 1: Drawings of the shoulder in the coronal oblique plane showing different types of tendon tears at the rotator cuff footprint. Figure 1a. Partial articular-sided supraspinatus tendon avulsion (PASTA) lesion with tendon failure on the articular side associated with a horizontal delamination of tendon fibres. Figure 1b. Concealed interstitial delamination (CID) lesion covered by intact tendon fibres on both the articular and the bursal sides. Figure 1c. Reverse PASTA lesion with a bursal-sided defect of the tendon, continuing to the subdeltoid bursa. Figure 1d. Full-thickness tear with a continuous extension of the defect from the joint space to the subdeltoid bursa.
Results

RESULTS:

Among the 984 MR images that were retrospectively reviewed, 81 MR images from 81 consecutive patients with tears at the rotator cuff footprint were included in our study (8.2%).

Thirty-two out of eighty-one (39.5%) footprint lesions were concealed interstitial delamination tears (Fig. 2). Most of the CID tears were located at the supraspinatus tendon (14 patients out of 32 patients with CID tears). Full-thickness tears (Fig. 3) accounted for 25 out of 81 (30%) lesions. Full-thickness tears were predominantly located at the supraspinatus tendon (20 patients out of 25 patients with full-thickness tears), and 14 and 10 out of 81 (17.2% and 12.3%) lesions were PASTA (Fig. 4) and reverse PASTA (Fig. 5), respectively, most of them located at the supraspinatus tendon.

Ultrasound imaging was performed in 25 patients at a later time. The period between the MR and ultrasound imaging was 1 day and 2 years and 3 months. There is no changes in the ultrasounds findings in 12 patients. Ultrasound showed no changes in 12 patients (Fig. 6) and showed an increase of the injury in eight patients (Fig. 7). No correlation between MRI and ultrasound imaging was found in five patients (MRI found CID whereas the ultrasound was normal in three patients and showed focal tendinopathy in two patients). A Constant Score was obtained for 32 patients. Of these 32 patients, 16 gave a value of 5 or less for pain (50%) and 25 gave a value of 10 or less for pain (78%). These findings suggest that tears at the rotator cuff footprint are often associated with the presence of symptoms. Of these 32 patients, only 8 gave a value of 15 (no pain).

DISCUSSION:

Rotator cuff (RC) disease is the most common cause of shoulder pain and dysfunction in adults. Tears occurring at the RC can be classified into partial-thickness or complete tears, where partial-thickness tears can be located on either the bursal or the articular side. Lesions involving the mid-substance of the tendon are called interstitial or intrasubstance tears. It has been reported that most of the tears occur in a region about 1 cm medial to the tendon insertion, the so-called "critical zone". In 1934, Codman described a type of tear where tendon fibres were torn at the bony attachment at the greater tuberosity, which he called "rim-rent" tears [1]. "Rim-rent" tears were defined as partial-thickness tears occurring on the articular side of the rotator cuff at the tendon insertion on the greater tuberosity. A more anatomical description of this type of tear is a partial articular-sided supraspinatus tendon avulsion (PASTA) lesion, which is virtually synonymous with rim-rent tears. Only a few radiological publications concentrated on the imaging of tears at the rotator cuff footprint [2, 3].
A more detailed anatomical description of this type of tear was recently reported by Schaeffeler et al. and called “tears at the rotator cuff footprint”, which represents the region of humeral insertion of the supraspinatus and infraspinatus tendons [4].

The incidence of tears at the rotator cuff footprint in our population was 81 out of 984, or 8.2%, similar to that reported by Vinson et al., who found a total of 49 rim-rent tears in 200 consecutive shoulder MRIs. The results of our study support the theory that tears at the rotator cuff footprint are not an uncommon type of tear.

Most of the footprint lesions in our study were CID lesions (39.5%), but full-thickness tears accounted for 30% of all lesions at the footprint. Our results are similar to those of Vinson et al., and also suggest that bursal-sided partial-thickness tears are less common than previously believed, constituting only 12.3% of all rotator cuff tear at the footprint in our study.

It was mentioned that preoperative MR imaging is helpful in drawing attention to the presence of a concealed tear that might otherwise be missed on arthroscopic inspection.

Little is known of the natural history and spontaneous healing of partial tears. Codman's assertion that spontaneous healing occurs has not been substantiated by histological examinations [1]. In a series of 35 en-bloc histological sections from surgical specimens of partial tears, Fukuda et al. observed no active repair in any portion examined [6]. Yamanaka and Matsumoto undertook an arthrographic follow-up over 2 years on 40 joint-side tears that had not been operated on, and found that 10% had decreased in size and 10% had disappeared, but the remaining 80% became larger or progressed to full-thickness lesions [7].

During our study we observed eight cases that were treated conservatively and showed progression on ultrasound. Since making this observation, we also noted that many full-thickness rotator cuff tears at the footprint appear on imaging as if they had originated as partial tears at the footprint and then progressed to involve the full thickness of the tendon. This observation supports the progression theory and underlines the importance of diagnosing partial-thickness rotator cuff tears.

Arthroscopy has enabled the visualization of partial thickness tears on the joint and bursal sides. However, the diagnosis of intratendinous tears still remains elusive.

The indications for the surgical treatment of partial thickness tears have not been clearly delineated. Surgical treatment is generally considered for patients with symptoms of sufficient intensity and duration and in whom imaging suggests the presence of partial or small full-thickness lesions. Surgery may involve debridement of the partial tear, acromioplasty alone, acromioplasty and debridement, or repair of the cuff in addition to acromioplasty.

Our study has several limitations. First, the design of the study is retrospective. Second, we used MRI instead MR arthrography. Third, not all of our patients underwent
arthroscopy. Therefore, the findings of rotator cuff tears were not correlated with the gold standard. Moreover, in some cases, the time between the realization of MRI and ultrasound was not enough to draw any conclusions about the evolution of the tears.

Images for this section:

Fig. 1: FIGURE 1: Drawings of the shoulder in the coronal oblique plane showing different types of tendon tears at the rotator cuff footprint. Figure 1a. Partial articular-sided supraspinatus tendon avulsion (PASTA) lesion with tendon failure on the articular side associated with a horizontal delamination of tendon fibres. Figure 1b. Concealed interstitial delamination (CID) lesion covered by intact tendon fibres on both the articular and the bursal sides. Figure 1c. Reverse PASTA lesion with a bursal-sided defect of the tendon, continuing to the subdeltoid bursa. Figure 1d. Full-thickness tear with a continuous extension of the defect from the joint space to the subdeltoid bursa.
Fig. 2: FIGURE 2: Figure 2a. Drawing of the shoulder in the coronal plane shows a concealed interstitial delamination (CID) lesion. Figure 2b. Coronal oblique MRI of the right shoulder in a 60-year-old female patient. Proton density-weighted fat-suppressed MR shows a CID lesion as a hyperintense signal supraspinatus tendon lesion. The MR image shows intact tendon fibres on both the articular and the bursal sides.
**Fig. 3:** FIGURE 3: Figure 3a. Drawing of the shoulder in the coronal plane shows a full-thickness tear. Figure 3b. Fat-suppressed coronal proton density-weighted MRI in a 52-year-old male patient shows hyperintensity from the joint through the entire supraspinatus tendon. Figure 3c. Sagittal oblique T2-weighted MRI in the same patients shows the full thickness tears.
**Fig. 4:** FIGURE 4: Figure 4a. Drawing of the shoulder in the coronal plane shows a partial articular-sided supraspinatus tendon avulsion (PASTA). Figure 4b. Fat-suppressed coronal proton density-weighted MRI in a 6-year-old female patient shows a lesion with tendon failure on the articular side associated with a horizontal delamination of tendon fibres. Figure 4c. Sagittal oblique T2-weighted MRI in the same patients shows PASTA lesions.
**Fig. 5**: FIGURE 5: Figure 5a. Drawing of the shoulder in the coronal plane shows a partial articular-sided supraspinatus tendon avulsion (PASTA). A 65-year-old man with a Reverse PASTA lesion. Figure b. Fat-suppressed proton density-weighted coronal oblique and, Figure c, a T2-weighted MRI in the sagittal oblique plane shows a bursal-sided tendon avulsion (reverse PASTA) with a bursal-sided defect of the tendon, continuing to the subdeltoid bursa.
**Fig. 6:** FIGURE 6a. Coronal oblique fat-suppressed proton density-weighted and oblique sagittal T2-weighted MR image of a 52-year-old male patients shows a full-thickness tear at the supraspinatus footprint of 11 mm in a study performed on 1/1/2011. The same patient's right shoulder ultrasound in the cross-sectional and longitudinal plane performed on 4/28/2011 shows an unchanged full-thickness tear of 11 mm.
Fig. 7: FIGURE 7: Figure 7a and 7b. Coronal and axial oblique proton density-weighted MRI of the right shoulder in a 52-year-old male patient shows a CID lesion as a hyperintense signal supraspinatus tendon lesion. One year later, a coronal and axial oblique proton density-weighted MRI shows a full-thickness tear of the supraspinatus tendon. The ultrasound image (not shown) showed the same findings.
Conclusion

CONCLUSION:
Most rotator cuff tears occur in a region about 1 cm medial to the tendon insertion. Only a few radiological publications have concentrated on the imaging of tears at the rotator cuff footprint. In our study, most of these lesions were CID and full-thicknesstears. Detection of concealed types of tears is of special importance as these lesions might be invisible at arthroscopic shoulder surgery. Partial rotator cuff tears can progress and do not heal on their own.

References

REFERENCES:

Personal Information