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MUSCULOSKELETAL IMAGING

TECHNICAL NOTE

Demystifying ABER (ABduction and External Rotation) sequence in shoulder MR arthrography

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ABSTRACT

ABduction and External Rotation (ABER) sequence in magnetic resonance (MR) arthrography of the shoulder is particularly important to better depict abnormal conditions of some glenohumeral joint structures and surrounding tissues by making imaging possible under a stress position relevant to pathologic conditions. Among the structures and tissues better depicted in this position are articular surface of the supraspinatus tendon, anteroinferior portion of the glenoid labrum, and anterior band of the inferior glenohumeral band. Despite these benefits of the ABER sequence, it is either not being used extensively as part of shoulder MR arthrograms or, when utilized, not properly assessed, mostly due to some practical difficulties in setting up the sequence and unfamiliarity with the alignment of structures displayed on MR images. In this technical note, we aimed to explain the ABER sequence planning in a step-by-step manner with emphasis on scout series set-up, and also present an outline of anatomic landmarks seen on ABER images.

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Magnetic resonance (MR) imaging portion of a routine shoulder MR arthrography exam is performed with the patient lying in supine position on the scanner table with both arms lying alongside the torso, in the same position as a routine shoulder MR imaging exam. An additional sequence with the patient's arm ABducted and Externally Rotated (i.e., the so-called "ABER view") has been shown to be useful not only in clarifying equivocal findings, but also in making diagnoses that may not be readily visible on a routine MR arthrography exam (1, 2).

Despite the benefits of the ABER sequence, it is either not being used extensively as part of shoulder MR arthrograms or, when utilized, not properly assessed, mostly due to some practical difficulties in setting up the sequence and unfamiliarity with the alignment of structures displayed on MR images. A true ABER position with 90° of abduction and 90° of flexion of the arm (Fig. 1a) is not feasible with closed-bore MR scanners, which constitute the majority. Therefore, the patient usually has to make >90° of abduction to fit into the magnet (Fig. 1b). On one hand it is quite hard for many patients with shoulder problems to assume such a position for prolonged periods. On the other hand, an improperly aligned imaging plane for ABER sequence would be of limited- or no-use, rendering the patient burden futile. It is, therefore, particularly important to take extra steps to make sure the ABER sequence is properly planned.

In this technical note, we aimed to explain the ABER sequence planning in a step-by-step manner with emphasis on scout series set-up, and also present an outline of anatomic landmarks seen on ABER images.

Technique

Helping to achieve patient comfort during ABER

Before proceeding with the set-up of scout series, liberal padding should be used to reduce patient discomfort in the ABER position, which is by itself uncomfortable for many patients with shoulder problems. This measure will greatly help to maximize, if not ensure, patient cooperation, which is crucial for an ideally set up ABER sequence.

Setting up scout series for ABER MR arthrography images

Several (usually two or three) scout series have to be obtained to allow proper imaging plane alignment for the ABER sequence. The relatively short time spent for these scout series will pay off with the proper acquisition of ABER (T1-weighted fat-saturated) MR images. The goal here is to have axial oblique (or coronal oblique) images that pass through the supraspinatus and anteroinferior aspect of the glenoid in a 90° alignment with respect to the glenoid joint surface. Therefore proper scout

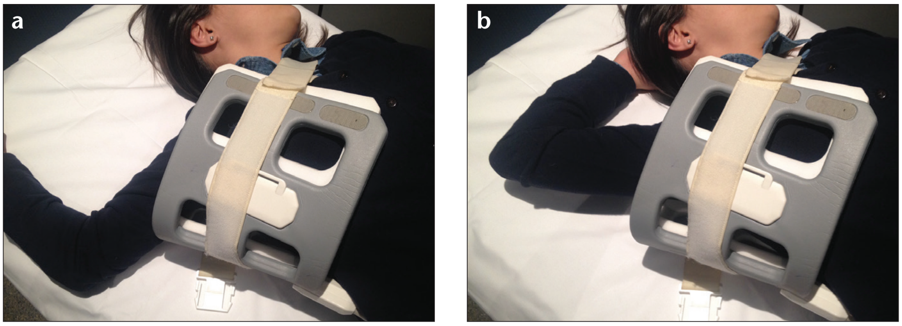

Figure 1. a, b. True ABER position **(a)** as an apprehension (or stress) test for orthopedists entails 90° of abduction and 90° of flexion of the arm at the shoulder. During ABER positioning for MR arthography of the shoulder, the patient usually has to make >90° of abduction of the arm to fit into the magnet **(b)**.

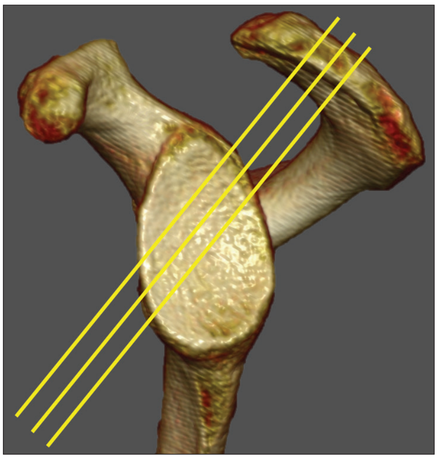

Figure 2. The desired plane of axial oblique ABER sequence superimposed on a volume-rendered computed tomography image showing the glenoid cavity en face.

Figure 3. A coronal scout image passing through the glenohumeral joint space that can be used for planning of the desired axial oblique ABER sequence.

images that show two features have to be obtained: The first is the glenohumeral joint on a coronal (or coronal oblique) plane, whereby the resultant—and desirable—axial oblique ABER images will be perpendicular to the glenoid joint surface (and usually—but not necessarily always—parallel to the humerus shaft). The second is the glenoid joint surface (or its vicinity) on a sagittal oblique plane, whereby the resultant axial oblique ABER images will be ideally passing through the acromion, the glenohumeral joint space, and the anterior-inferior aspect of the glenohumeral labral capsular structures (Fig. 2).

Below is a step-by-step description of how to obtain an ABER sequence with a correct planar alignment:

Step 1. Setting up the initial scout series

Obtain a regular set of axial, coronal, and sagittal scout images through the shoulder.

Repeat this step to ensure that the images are passing through the glenohumeral joint space, if necessary.

Step 2. Setting up the scout series for proper coronal oblique rendering of the glenohumeral joint

Using the initial set of axial scout images acquire a second set of scout images to display the glenohumeral joint in a coronal oblique plane (Fig. 3). If the glenohumeral joint is already well displayed in Step 1, this step may be skipped.

Step 3. Setting up the scout series for proper sagittal oblique rendering of the glenoid joint surface (or its vicinity)

Ensure that you include the glenoid joint surface and/or the acromion on this sagittal oblique series (Fig. 4).

Step 4. Setting up the actual ABER series in two dimensions

Using the coronal scout image from Step 1 or 2 and the sagittal scout image from Step 3, set up the actual T1-weighted fat-saturated ABER sequence perpendicular to the glenoid joint surface (on the coronal oblique scout) and at the same time approximately 45° with respect to the long or short axis of the glenoid joint surface on the sagittal oblique scout, such that the imaging plane passes from the acromion or the superior-posterior glenoid clockface quadrant and through the anterior-inferior quadrant (Fig. 5).

Step 5 (optional). Setting up the actual ABER series in three dimensions

As an option—and if the patient's tolerance permits—a coronal oblique three-dimensional (3D) T1-weighted fat-saturated sequence can be obtained for later properly (i.e., as described in Step 4) reformatted plane determination on a workstation. The coronal oblique 3D plane can be prepared perpendicular to the glenoid joint surface on the axial scout images from Step 1 and parallel to the long axis of the glenoid joint surface on the sagittal oblique scout images from Step 3. Reformats from such a sequence would also enable triangulation to identify confusing structures.

Identifying relevant structures on the resultant ABER image

A characteristic ABER sequence would show the posterior portion of the supraspinatus tendon insertion onto the major tubercle and anterior-inferior glenoid labrum on the same slice (Fig. 6).

An anterior-to-posterior scroll through the ABER images would show the subscapularis tendon, middle glenohumeral ligament, biceps tendon and its insertion to the superior labrum, supraspinatus tendon, infraspinatus tendon, and acromion (Figs. 7, 8). Triangulation using the scout images (or, if obtained, images from the 3D sequence) would help identify many of the structures.

Discussion

In this technical note we described a step-by-step procedure to obtain properly aligned ABER images. It is important to realize the significance of this sequence in order to utilize it in MR arthrography of the shoulder. For orthopedists, 90° of abduction and

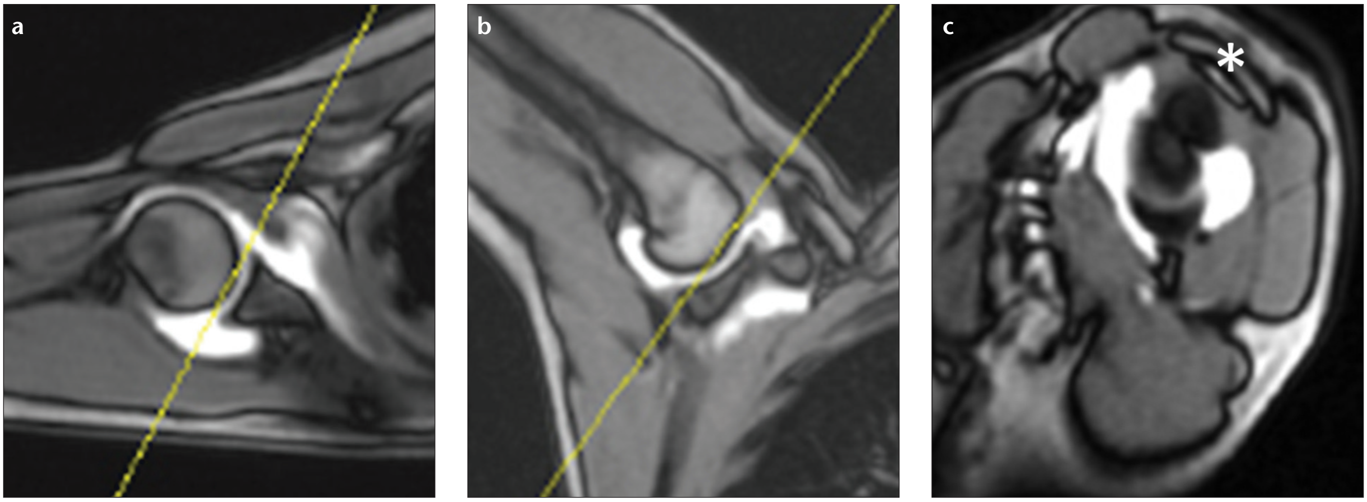

Figure 4. a–c. Axial **(a)** and coronal **(b)** scout images are used to obtain a sagittal oblique scout image **(c)** that shows the glenoid bone en face or the acromion (**c,** *asterisk*).

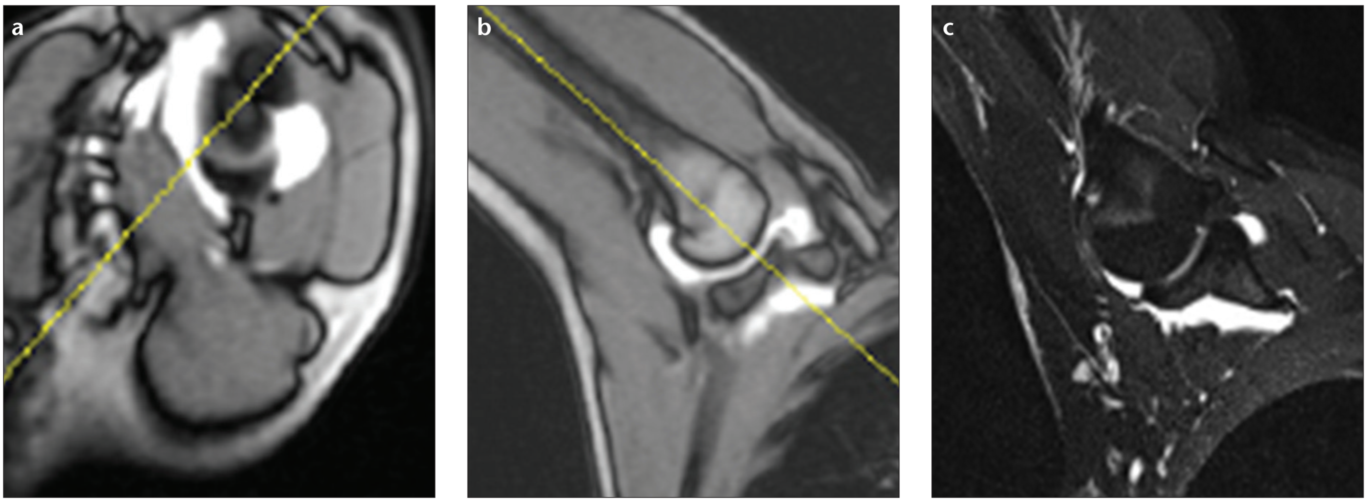

Figure 5. a–c. Sagittal oblique **(a)** and coronal or coronal oblique **(b)** images are used to acquire the desired axial oblique T1-weighted fat-saturated ABER sequence **(c)**. Axial oblique ABER images are perpendicular to the glenoid joint surface and are aligned 45° with respect to the long or short axes of the glenoid joint surface. Since the latter alignment is 45°, ABER images may well be considered as being "coronal oblique" as well as "axial oblique". It is important to note that, depending on the patient's actual degree of abduction, ABER images that are perpendicular to the glenoid joint surface do not necessarily have to pass through the humeral shaft in a parallel fashion.

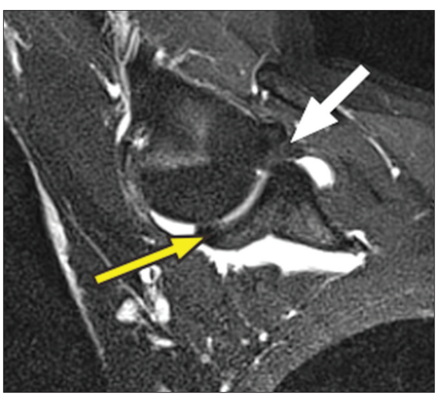

Figure 6. T1-weighted fat-saturated ABER MR image shows the posterior portion of the supraspinatus tendon insertion *(white arrow)* onto the major tubercle and anterior-inferior glenoid labrum *(yellow arrow)* on the same slice. The position of this image on scout series is shown as yellow lines in Fig. 5a and 5b.

90° of flexion of the arm at the shoulder represents a true apprehension (or stress) test (Fig. 1a) (3). Such a position would put the anterior band of the inferior glenohumeral ligament and the anteroinferior aspect of the glenohumeral joint capsule to a much greater stress compared to the position with the arm resting alongside the body. Additionally, during 90° of abduction and 90° of flexion of the arm, tension along the supraspinatus and infraspinatus tendons, where the majority of rotator cuff tears take place, decreases with kinking of those tendons and reduced effacement of their undersurface (articular surface) along the humeral head. This, in turn, makes partial undersurface tears of those tendons more readily visible. Moreover, in patients with glenohumeral internal rotation deficit and contracture of the posterior joint capsule glenohumeral contact point migrates slightly posterosuperiorly during the ABER position, which actually recreates the "cocking" phase of throwing. Such patients may have a posterior "peel-back" superior labral anteroposterior (SLAP) tear, whereby peeling back and torsion of the bicipital anchor during the late cocking phase of throwing transmits increased force to the posterior bicipital-labral complex and posterosuperior labrum, resulting in a posterior SLAP type 2 tear (2).

When compared with the routine axial shoulder MR images in which the patient's arm resides along the tor-

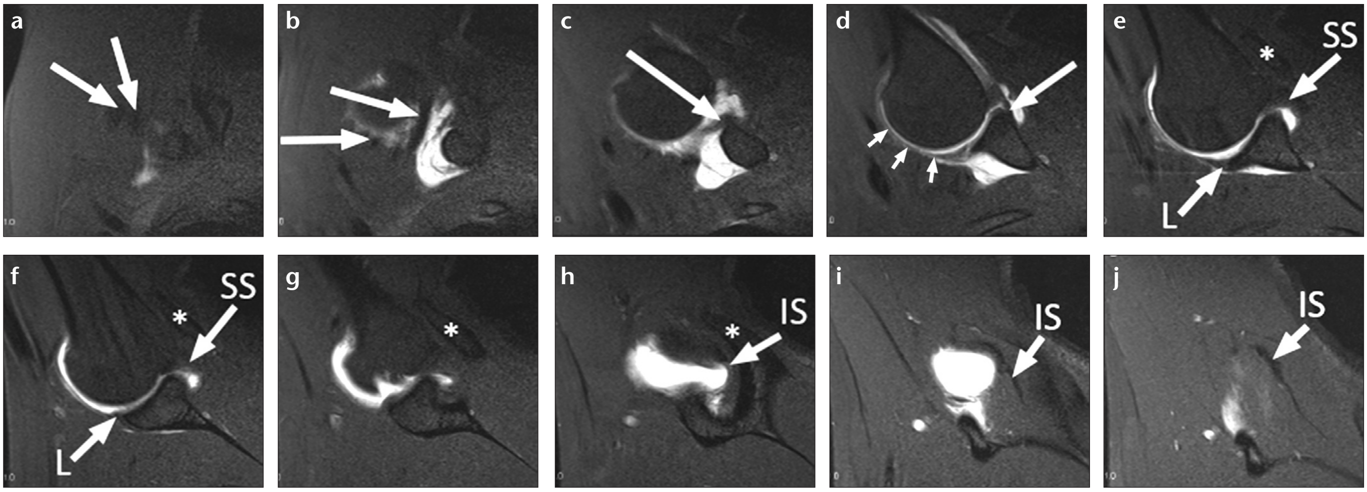

Figure 7. a–j. Axial oblique (or coronal oblique) T1-weighted fat-saturated ABER MR arthography images passing through the glenohumeral joint space **(a–j)** start from the anterior-superior aspect of the shoulder **(a)** and end at the posterior-inferior aspect **(j)**. Visible structures include the subscapularis tendon fibers (**a, b,** *arrows*), middle glenohumeral ligament (**c,** *arrow*), biceps tendon insertion to the superior labrum (**d,** *long arrow*), anterior band of the inferior glenohumeral ligament (**d,** *short arrows*), supraspinatus (SS) tendon **(e, f)**, anterior-inferior labrum (L) **(e, f)**, acromion (**e–h,** *asterisk*), and infraspinatus (IS) tendon **(h–j)**.

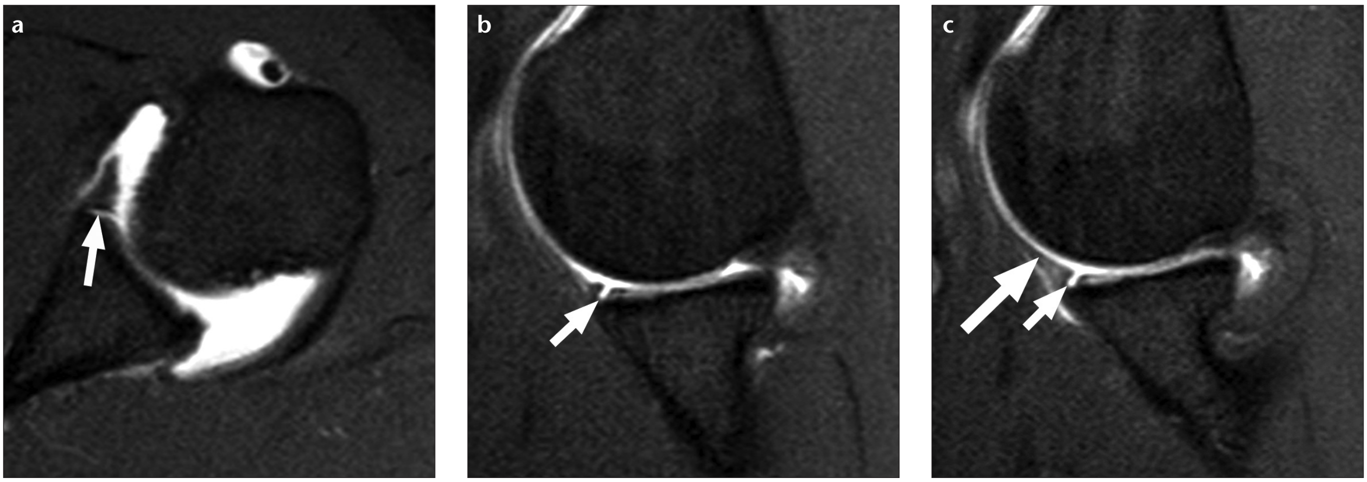

Figure 8. a–c. Axial T1-weighted fat-saturated MR arthrography image **(a)** of a 29-year-old male swimmer shows a tear at the base of the anterior-inferior glenoid labrum (**a,** *arrow*), which is better depicted on axial oblique (or coronal oblique) T1-weighted fat-saturated ABER images (**b, c,** *short arrows*) due to tension on the anterior-inferior labrum by the stretched anterior band of the inferior glenohumeral ligament (**c,** *long arrow*).

so, axial oblique imaging in the ABER position presents major changes in the alignment of structures surrounding the shoulder joint. Getting familiar with anatomic landmarks in this particular body position may be challenging. Nevertheless, we believe that understanding the proper planar alignment of this MR imaging sequence greatly helps in correctly identifying the relevant structures.

Conclusion

Proper acquisition of abduction and external rotation sequence during MR arthrography is feasible in many patients, facilitating perception of anatomic landmarks that are relevant to pathologic conditions searched. The degree of abduction depends on patients' tolerance; however, as long as perpendicular alignment with respect to the glenoid joint surface—rather than parallelism to the humeral shaft—is maintained, useful images may still be obtained.

Several scout series have to be obtained to ensure proper plane alignment for this sequence. Optionally—and depending on the patient's cooperation—a 3D T1-weighted fat-saturated sequence for later proper plane determination on a workstation would enable obtaining reformats that may also help to identify confusing structures.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Tirman PF, Bost FW, Steinbach LS, et al. MR arthrographic depiction of tears of the rotator cuff: benefit of abduction and external rotation of the arm. Radiology 1994; 192:851–856. [CrossRef]
2. Saleem AM, Lee JK, Novak LM. Usefulness of the abduction and external rotation views in shoulder MR arthrography. AJR Am J Roentgenol 2008; 191:1024–1030. [CrossRef]
3. Iyengar JJ, Burnett KR, Nottage WM, Harwin SF. The abduction external rotation (ABER) view for MRI of the shoulder. Orthopedics 2010; 33:562–565. [CrossRef]