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 subscapularis tendon, anteroinferior portion of the glenoid labrum, and anterior band of the inferior glenohumeral ligament. 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.

METHOD

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
images that show two features have to be obtained: The first is the gleno-
humeral joint on a coronal (or coro-
nal oblique) plane, whereby the re-
sultant—and desirable—axial oblique
ABER images will be perpendicular to
the glenoid joint surface (and usual-
ly—but not necessarily always—paral-
lel to the humerus shaft). The second
is the glenoid joint surface (or its vicin-
ity) on a sagittal oblique plane, where-
yby 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 gleno-
humeral 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 gle-
nojoint surface (or its vicinity)

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 im-
age from Step 3, set up the actual
T1-weighted fat-saturated ABER se-
quence perpendicular to the gleno-
d joint surface (on the coronal oblique
scout) and at the same time approxi-
mately 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 ac-
romion or the superior-posterior gle-
nojoint 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 determina-
tion on a workstation. The coronal
oblique 3D plane can be prepared
perpendicular to the glenoid joint sur-
face on the axial scout images from
Step 1 and parallel to the long axis of
the glenoid joint surface on the sagit-
tal 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 anteri-
or-inferior glenoid labrum on the same
slice (Fig. 6).

An anterior to posterior scroll through
the ABER images would show the sub-
scapularis tendon, middle glenohu-
meral ligament, biceps tendon and its
insertion to the superior labrum, supra-
spinatus 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.
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 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 torso, 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**