

MRI IMAGES AT A 45-DEGREE ANGLE THROUGH THE CERVICAL NEURAL FORAMINA: A TECHNIQUE FOR IMPROVED VISUALIZATION

Bradly S. Goodman, MD, Jon F. Geffen, DO, Srinivas Mallempati, MD, and Brad R. Noble, DO

Background: Traditional MRI imaging of the cervical neural foramina (NF) generally utilizes sagittal and axial views to delineate pathology. These views may not fully delineate NF pathology. Enhanced imaging and visualization of this area would benefit all interventionalists. The spinal interventionalist, in particular, routinely utilizes approximately a 45-degree fluoroscopic en face view for placement of needles for a cervical transforaminal epidural. The interventionalist relies on axi-

al MRI views to identify NF pathology that can be conceptually more difficult to analyze. Routine 45-degree oblique views through the NF, along with traditional axial views for correlation, more clearly demonstrate NF pathology.

Cases: Two cases are presented in which the 45-degree oblique views more clearly demonstrate neural foramina pathology.

Conclusion: These clinical cases demonstrate the clinical utility of the cervical

spine MRI 45 degree oblique technique and show cervical NF pathology that is not as easily identified on routine axial and sagittal sequences. We advocate the routine acquisition and examination of 45-degree cuts to help spinal practitioners better delineate NF pathology.

Key words: Cervical transforaminal epidurals, MRI cervical spine, 45-degree oblique views, fluoroscopy, neural foramina

Interventionalists routinely use MRI images to diagnose pathological changes of the spine and to plan their treatment approach. Pathology in the neural foramina (NF) is common, thus it is important to be able to identify it on these images. Traditional MRI sequences of the spine include sagittal, axial and coronal plane "slices". Due to the nearly sagittal orientation of the lumbar NF, sagittal imaging in the lumbar spine readily reveals this pathology (1). In contrast, the NF in the cervical spine is ori-

ented at nearly a 45-degree oblique position, and traditional cervical sagittal MRI images do not offer the same, clear view of the NF as is seen in the lumbar spine (2). While the cervical axial views are helpful in determining NF pathology, it has been reported that sagittal images are more limited in their ability to evaluate pathology in the NF of the cervical spine because of the oblique course of the NF with regard to the sagittal plane (3).

The purpose of this brief report is to demonstrate the clinical utility of this alternative MRI view with case reports that makes common NF pathology easier to identify. The 45-degree oblique view creates a cervical image similar to the lumbar sagittal views (4). In doing so, MRI scans using approximately 45-degree oblique cuts through the cervical NF will be shown to offer enhanced visualization of this area and thus improved detection of pathology.

Moreover, the interventionalist performing cervical injections, such as transforaminal epidurals, will find

these 45-degree views familiar and easy to work with, as they are similar to the fluoroscopic en face images routinely used by interventionalists in these procedures.

Two cases with their images and subsequent discussion will be presented to demonstrate this imaging technique.

CASE DESCRIPTIONS

Case 1

AG is a 38-year-old female with acute neck and right upper extremity pain of two weeks' duration. The distribution of her pain along with physical exam, suggest a right C6 radiculopathy. A cervical spine MRI was performed. Sagittal images readily showed reversal of cervical lordosis with kyphosis at C5-6 in Fig. 1. Axial imaging in Fig. 2 of the C5-6 disc demonstrates a posterior disc protrusion centrally and posterolaterally indenting the thecal sac but not the spinal cord with disc protrusion into the right C6 NF. Tradition-

From: The Department of Physical Medicine and Rehabilitation, University of Missouri, Columbia; and Alabama Orthopedic and Spine Center, Birmingham, Alabama

Address Correspondence: Bradly S. Goodman, MD, Alabama Orthopedic and Spine Center, 52 Medical Park East Dr, Suite 115, Birmingham, Alabama 35235

E-mail: drspudhead@aol.com

Disclaimer: There was no external funding in the preparation of this manuscript.

Conflict of Interest: None.

Manuscript received on: 08/02/2006

Revisions accepted: 9/13/2006

Accepted for publication on: 09/16/2006

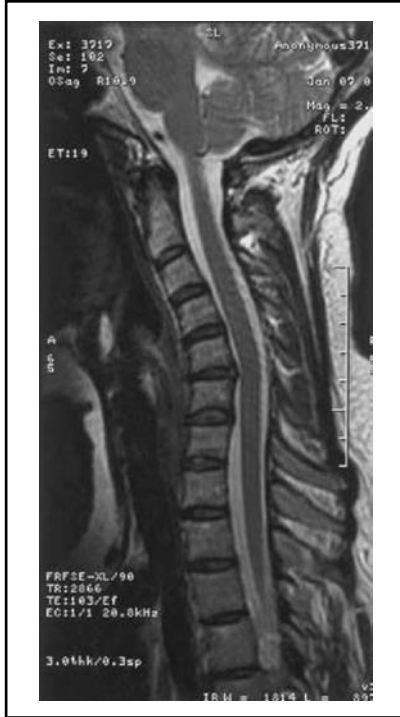


Fig. 1. *Sagittal view at the midline in Case 1. Posterior disc protrusion seen at C5-6.*

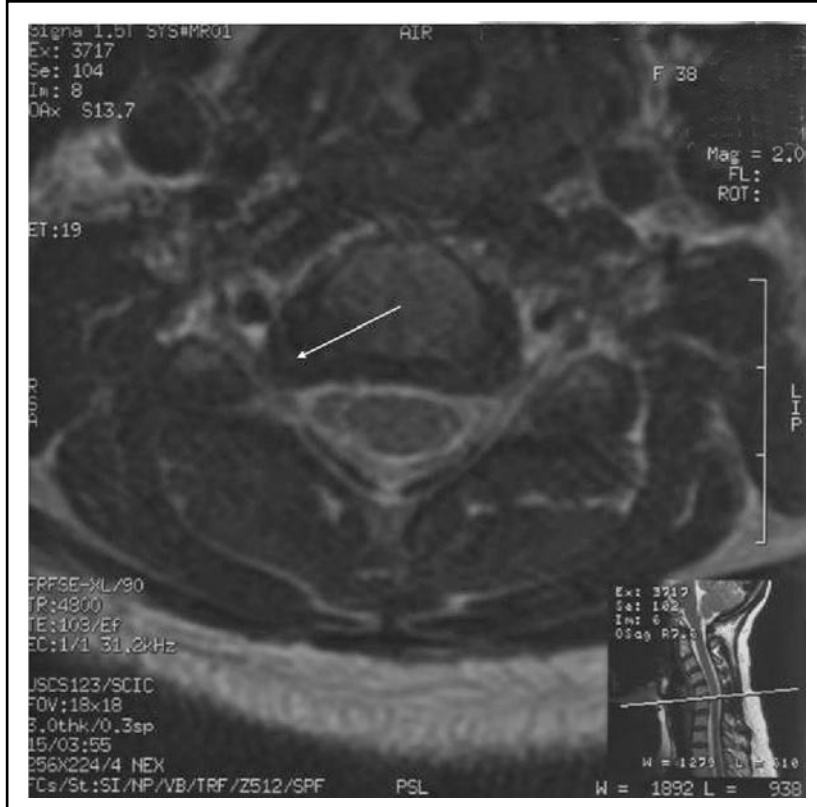


Fig. 2. *Axial view of right lateral disc protrusion with neuroforaminal stenosis at C5-6.*



Fig. 3. *Traditional sagittal view of the right neural foramina in Case 1.*



Fig. 4. *Axial view shows the trajectory of the 45-degree cuts through the neuroforamen in Case 1 at C5-6.*



Fig. 5. Forty-five-degree oblique view in Case 1 demonstrates significant neuroforaminal disc herniation on the right at C5-6.



Fig. 6. Sagittal view of the cervical spine in Case 2.



Fig. 7. Sagittal view slightly to right of midline in Case 2.

al sagittal imaging does not readily reveal any foraminal disc pathology as evidenced by Fig. 3. Fig. 4 shows the scout for a 45-degree oblique sagittal series through the NF. Forty-five-degree sagittal oblique cuts seen in Fig. 5 readily reveal the right-sided NF pathology to be far more prominent than previously appreciated on the sagittal images.

Case 2.

GH is a 44-year-old male with pain and weakness in the right side of the neck and right upper extremity of one-month duration. His history and examination suggest a right C6 radiculopathy. A cervical spine MRI was obtained. Sagittal imaging revealed loss of lordosis with decreased disc heights at C4-5 and C5-6 in Fig. 6. In the sagittal slice to the right of midline (Fig. 7), degenerative changes are seen most prominently at C4-5, C5-6, and C6-7. Axial images at the C5-6 level reveal a posterolateral and lateral disc protrusion with narrowing of the right neural foramen on Fig. 8.

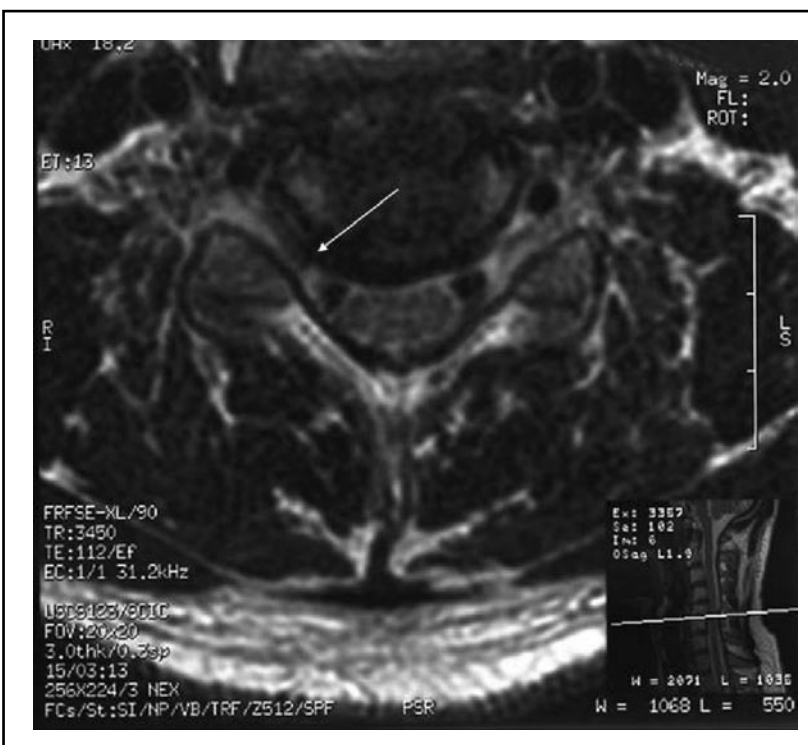


Fig. 8. Axial view of C5-6 with right-sided neuroforaminal canal narrowing in Case 2.



Fig. 9 Axial view demonstrating the location of the 45-degree sagittal cuts through the neuroforamen in Case 2.



Fig. 10. Forty-five-degree oblique view demonstrates disc osteophyte complex creating significant neuroforaminal stenosis at C5-6 in Case 2.

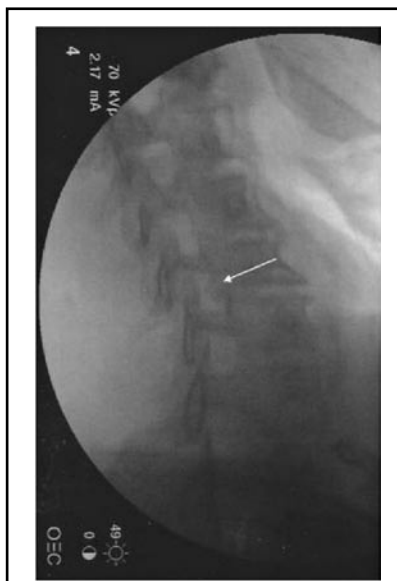


Fig. 11 Fluoroscopic views of the same patient demonstrate the stenosis at the C5-6 level. The 45-degree oblique demonstrated this pathology in this same plane of imaging

Fig. 9 demonstrates a scout axial view to show where the 45-degree oblique will traverse the NF. Fig. 10 demonstrates the 45-degree sagittal oblique cuts through the NF and more readily demonstrates the neuroforaminal stenosis on the right at C5-6. Fig. 11 is the fluoroscopic en face image of patient GH during the set up for cervical transforaminal epidural injection. Again, the osteophyte complex is visualized at the C5-6 level corresponding well with the 45-degree oblique MRI series through the NF.

DISCUSSION

It is the purpose of this brief report to describe, with clinical cases, MRI images with cervical sagittal 45-degree oblique cuts to enhance visualization of pathology in the NF. These types of cuts are sporadically used throughout the country. Pech (5) demonstrated that MR images perpendicular to cervi-

cal spinal nerves allowed the structures and the foraminal boundaries to be visualized. Yenerich and Haughton (6) reported on the oblique MRI images of the cervical NF in cadavers and showed that the foramen could be visualized for several levels in a single image. These cases demonstrate how these images are obtained and the pathology that can be readily identified by this imaging technique.

The persistent problem with cervical spine MRI imaging relates to two important variables, the small size of the structures (compared with the lumbar spine) and the thickness of the sections. Taking 45 degree cuts through the NF addresses the pathology en face and may delineate this pathology better. Our protocol generally utilizes five, 5 millimeter cuts through each neuroforamen (Fig. 4) at T2 weighting. With traditional sagittal imaging in the cervical spine, in contrast to the lumbar spine, the NF

pathology is more difficult to appreciate due to the oblique orientation of the cervical NF.

The concept of oblique cervical MRI imaging, although not new, does add to a new arena of radiological imaging, namely in modified imaging for spinal interventionalists. We have already seen many modifications with respect to cross-sectional imaging uniquely suited to the interests and intentions of the interventional pain community. Examples include: 1) Fat suppressed MRI images to better document synovial cyst effusions, acute vertebral fractures (7), and ligamentous injury (8,9); 2) Prone axial full field of view abdominal CT images through specific disc spaces as part of a presurgical workup prior to planned microendoscopic discectomy; and 3) Weight-bearing MRI scans, with flexion and extension views, to bring out disc derangement (10,11).

The idea of oblique cervical MRI is analogous to adjusting the gantry to obtain axial cuts in parallel through the lumbar discs. Angling through the disc spaces is only occasionally provided for and instead stacked images from top to bottom are generally obtained. Add to this the inherent problem of low resolution open MRI which further limits the ability of both the radiologist and interventionalist to accurately interpret the severity of disease. By combining these projections with oblique plain x-rays or even CT scans (similarly obtained or with reconstructed images), the evaluator can more accurately assess foraminal pathology and thus more appropriately direct treatment.

There are some factors which may account for the lack of utilization of the 45 degree oblique cuts. Many, if not

most, cervical MRI's are not ordered by minimally invasive spinal interventionalists. The intent is generally to triage for major anatomic pathology, rather than to evaluate for subtle changes that may account for significant physiologic difficulties. In addition, there is a paucity of literature describing the benefits of these additional views and consequently, there is a lack of awareness of their potential benefit in interpreting pathology in the NF and also in how to obtain these special views.

In Case 1, the pathology was evident on traditional axial views only but not on traditional sagittal views. The 45-degree sagittal views more clearly demonstrate the pathology, making one less apt to potentially overlook NF encroachment.

In Case 2, the pathology is identifiable again only on axial images. In this instance however, the findings on axial imaging are much more subtle (due to volume averaging) and therefore may be potentially overlooked. To minimize this phenomenon, thinner axial cuts would be beneficial. In addition, the 45-degree oblique cuts further helped to visualize the pathology in the NF at C5-6. They also provide the en face view that the spinal injectionist routinely utilizes when performing cervical transforaminal epidural injections and other cervical spinal procedures.

The predominant drawback of these images is the increased time the patient spends in the scanner to obtain the additional views. However, the obvious advantage of the 45-degree sequences is that it aids the treating physicians, particularly the spinal interventionalist, with a more clearly delineated view of the NF.

AUTHOR AFFILIATION:

Bradly S. Goodman, MD

Assistant Professor
University of Missouri at Columbia
Dept of Physical Medicine and Rehabilitation
Alabama Orthopedic and Spine Center
52 Medical Park East Drive,
Suite 115
Birmingham, AL 35235
Email: drspudhead@aol.com

Jon F. Geffen, DO

Interventional Pain Physician
Puget Sound Spine Institute
1515 Martin Luther King jr, Way
Tacoma, WA 98405.
Email: geffenj@yahoo.com

Srinivas Mallempati, MD

Fellow, Pain Medicine
University of Missouri at Columbia
Email: msrini@gmail.com

Brad Noble, DO

Interventional Pain Physician
Pain Management
1601 E. Broadway, lower level
Columbia, MO 65201
Email: blockdoc@gmail.com

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