

Clinical Study

# Diagnostic value of oblique magnetic resonance images for evaluating cervical foraminal stenosis

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## Abstract

**BACKGROUND CONTEXT:** The benefits of oblique magnetic resonance imaging (MRI) reformations to assess cervical neural foramina have been reported previously in clinical and cadaveric studies. But there is a paucity of literature investigating intra- and interobserver variabilities for assessing cervical foraminal stenosis using oblique MRI views.

**PURPOSE:** To determine the value of oblique MRI views compared with axial and sagittal views for assessing foraminal stenosis of the cervical spine using intra- and interobserver variabilities.

**STUDY DESIGN:** A retrospective study.

**PATIENT SAMPLE:** Twenty-six patients were included.

**OUTCOME MEASURES:** Two independent reviewers blindly identified the presence of foraminal stenosis as definite or indeterminate on the sagittal, axial, and oblique views. The assessments using the different views were compared using an independent *t* test. Intra- and interobserver variabilities were assessed using Kappa analysis.

**METHODS:** We evaluated the cervical spine MRIs of patients with varying degrees of foraminal stenosis. The mean age of the patients was 60.8 years (range 50–86 years). Male to female ratio was 16:10. The oblique images were obtained by reformatting the scans perpendicular to the long axis of the right and left neural foramina, respectively.

**RESULTS:** The oblique or axial views had significantly greater confidence rates for determining the presence of foraminal stenosis than the sagittal views (92.3%, 88.1% vs. 58.0%, respectively, *p* = .000). The oblique view had significantly better intraobserver agreement than the sagittal and

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The disclosure key can be found on the Table of Contents and at [www.TheSpineJournalOnline.com](http://www.TheSpineJournalOnline.com).

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axial images. Both the axial and oblique views had significantly better interobserver agreement than the sagittal images.

**CONCLUSIONS:** Oblique MRI views of the cervical spine significantly reduce the degree of intra- and interobserver variabilities and increase observer confidence in the assessment of foraminal stenosis. Our results suggest that routine use of oblique cervical MRI views might be useful for evaluating cervical foraminal stenosis. © 2015 Elsevier Inc. All rights reserved.

**Keywords:** Cervical spine; Magnetic resonance image; Oblique MRI; Foraminal stenosis; Observer variability; Observer confidence

## Introduction

Standard magnetic resonance imaging (MRI) series typically use only axial and sagittal views. Theoretically, an imaging plane perpendicular to the cervical neural foramen might be more effective for demonstrating stenosis around cervical spinal nerve roots. The use of oblique images to display the cervical spine neural foramen is common with plain radiography [1], or computed tomography (CT) examinations [2], but is not routinely used in MRIs of the cervical spine. The benefits of these oblique reformations by CT, including improved demonstration of anatomic relations, have been demonstrated [2]. Although the benefits of oblique reformations of MRI to assess cervical spine neural foramina have been reported previously in cadaveric [3–7] and clinical studies [8–13], we are unaware of any literature comparing observer confidence for assessing foraminal stenosis using sagittal, axial, and oblique reformation of cervical spine MRIs. The purpose of this study was to determine the value of oblique MRI views compared with axial and sagittal views for assessing foraminal stenosis of the cervical spine using intra- and interobserver variabilities.

## Materials and methods

This study was approved by the institutional review board at the institution of the corresponding author (IRB number: 2013-II118). The MRIs were from 26 patients with cervical radiculopathy because of varying degrees of neural foraminal stenosis, who had undergone anterior cervical discectomy and fusion with complete resolution of their symptoms. We excluded those with a history of spinal trauma and any operations for trauma, infection, or tumor. The age of 16 men (mean, 60.4 years) and 10 women (mean, 62.0 years) ranged from 50 to 86 years. In addition to the standard sagittal and axial cervical images, we evaluated oblique images that were created by reformatting the images in a plane perpendicular to the long axis of the neural foramina, 45° from the sagittal and coronal planes, respectively. A total of 312 neural foramina from C2–C3 to C7–T1 were assessed using sagittal, axial, and oblique images by two independent experienced spine surgeons who were blinded to the clinical diagnosis. In addition,

the assessors were not aware of the source population of the MRIs. They also were not informed about the purpose of the study. They evaluated the MRIs in a randomized sequence and without discussion of the findings to minimize possible bias. The images were reread 1 month apart to determine the intraobserver reliability. The assessment was classified as definite for normal (Fig. 1) or foraminal stenosis (Fig. 2). A foramen was read as being stenotic when there was obliteration of the perineural fat surrounding the nerve root (Fig. 2) [14]. An assessment of “indeterminate” was made when the observer could not judge the presence of foraminal stenosis with confidence. All MRIs were obtained using a 1.5-T superconductive imager (Intera; Koninklijke Philips Electronics N.V., Amsterdam, the Netherlands) under the following settings: oblique T2-weighted fast spine-echo imaging (repetition time [TR]/echo time [TE] [3500/148.58], thickness of slice 2 mm, field of view 249 mm, matrix size 512×247, number of excitation 3).

All statistical analyses were performed with an SPSS version 13.0 for Windows (IBM, Chicago, IL, USA). The



Fig. 1. Normal cervical neural foramina (an oblique view).

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