With traditional surgical treatments for trigeminal neuralgia the presence of vascular compression guides both the selection of the appropriate procedure and the likelihood of symptomatic improvement. Brisman, et al., recently demonstrated that the presence of contact between a blood vessel and the trigeminal or fifth cranial nerve, as revealed on high-resolution MR imaging, may predict a particularly favorable response to GKS. As a result, interest has been renewed in defining imaging methods that may be used during stereotactic microradiosurgery to identify vascular compression of the fifth cranial nerve.

Clinical Material and Methods

We studied our most recent 25 patients. Patients underwent neuroimaging (SIEMENS 1.5 T Vision) after which CISS and 3D-Flash sequences were fused.

Results

In 24 of the 25 patients, the fifth cranial nerve, surrounding vessels, and areas of compression could be reliably identified using CISS/3D-Flash. The MR images were acceptable despite patients’ history of microvascular decompression, radiofrequency (RF) ablation, or concomitant disease. In one of 25 patients with a history of multiple RF lesions, the visualization was inadequate due to severe trigeminal nerve atrophy.

Discussion

Gamma knife surgery has been shown to be very useful in treating both primary and secondary trigeminal neuralgia. Although several parameters, such as pre-

Object The authors undertook a study to identify magnetic resonance (MR) imaging techniques that can be used reliably during gamma knife surgery (GKS) to identify the trigeminal nerve, surrounding vasculature, and areas of compression.

Methods. Preoperative visualization of the trigeminal nerve and surrounding vasculature as well as targeting the area of vascular compression may increase the effectiveness of GKS for trigeminal neuralgia. During the past years our gamma knife centers have researched different MR imaging sequences with regard to their ability to visualize cranial nerves and vascular structures. Constructive interference in steady-state (CISS) fusion imaging with three-dimensional gradient echo sequences (3D-Flash) was found to be of greatest value in the authors’ 25 most recent patients.

In 24 (96%) out of the 25 patients, the fifth cranial nerve, surrounding vessels, and areas of compression could be reliably identified using CISS/3D-Flash. The MR images were acceptable despite patients’ history of microvascular decompression, radiofrequency (RF) ablation, or concomitant disease. In one of 25 patients with a history of multiple RF lesions, the visualization was inadequate due to severe trigeminal nerve atrophy.

Conclusions. The CISS/3D-Flash fusion imaging has become the preferred imaging method at the authors’ institutions during GKS for trigeminal neuralgia. It affords the best visualization of the trigeminal nerve, surrounding vasculature, and the precise location of vascular compression.

KEY WORDS: • constructive interference in steady-state • cranial nerve • magnetic resonance imaging • trigeminal neuralgia • three-dimensional gradient echo
vious surgery and underlying systemic disease, have been linked to the effectiveness of this treatment, the importance of vessel compression has only recently been noted.5

Several imaging methods have been used to identify areas of vascular compression in cases of trigeminal nerve. Although conventional MR imaging may be adequate to visualize the fifth cranial nerve and any vessels in proximity, it provides a somewhat crude estimate of the exact point of contact. The use of more advanced MR imaging techniques such as high-definition MR angiography, multiplanar reconstruction, 3D fast inflow with steady-state precession has enabled improved sensitivity and specificity in identifying areas of compression.
visualization of cranial nerves and vascular structures. In our centers we have tried numerous MR imaging sequences and combinations of these sequences to determine which produces the best simultaneous visualization of both the cranial nerve and the vessel. In our experience, images produced by the fusion of CISS images with 3D-Flash images, particularly when used with contrast enhancement, are the most reliable.

The CISS is an MR imaging sequence with an extensive and proven track record in cranial nerve imaging. The primary benefit of this series is the sharp contrast between soft tissues and CSF, which allows very vivid visualization of cranial nerves within CSF spaces such as cisterns. As a high-volume sequence, it also allows for high-resolution thin-slice MR images. The 3D-Flash technique allows excellent visualization of intracranial vessels, including both arteries and veins.

Fusion images derived from these two techniques yield numerous benefits. Both the vessels and the fifth cranial nerve are visualized with superior clarity. Tissue margins are very sharp and structures have anatomically predictable imaging patterns. The nerve appears as a hypointense structure compared with the CSF with very crisp margins. Vessels appear as hollow tubes. Unlike other imaging methods,
both the vessel lumen and wall can be clearly demonstrated 
and differentiated. The exact location of contact between 
the vessel wall and the nerve can be accurately pinpointed.

References
neurovascular compression in patients with trigeminal neuralgia 
by use of three-dimensional reconstruction from two types of 
high-resolution magnetic resonance imaging. Neurosurgery 51: 
956–961, 2002
MRA and MPR in detecting vascular compression for trigeminal 
nergia or hemifacial spasm: comparison with oblique sagittal 
specificity of MRA in the diagnosis of neurovascular compression 
in patients with trigeminal neuralgia. A correlation of MRA and 
4. Brisman R: Gamma knife radiosurgery for primary management 
for trigeminal neuralgia. J Neurosurg 93 (Suppl 3): 
159–61;159–161, 2000
5. Brisman R, Khandji AG, Mooij RB: Trigeminal nerve-blood ves-
sel relationship as revealed by high-resolution magnetic resonance 
imaging and its effect on pain relief after gamma knife radio-
surgery for trigeminal neuralgia. Neurosurgery 50:1261–1266, 
discussion, 2002
for idiopathic and secondary trigeminal neuralgia. J Neurosurg 
93 Suppl 3:147–151, 2000
sion in trigeminal neuralgia: a correlation of three-dimensional 
time-of-flight magnetic resonance angiography and surgical find-
ionsal visualization of neurovascular compression syndromes. 
9. Heine C, Klingebl R, Lehmann R: Three-dimensional MR visu-
alization of the intracisternal course of the cranial nerves V-VIII 
and a T2 w. 3D turbo spin echo sequence for the anatomical study 
of facial and vestibulocochlear nerves. J Neuroradiol 27: 
173–178, 2000
treatment of trigeminal neuralgia in multiple sclerosis patients. 
Stereotact Funct Neurosurg 79:44–50, 2002
12. Jannetta PJ: Preoperative evaluation of neurovascular compression 
in patients with trigeminal neuralgia by use of three-dimensional 
reconstruction from two types of high-resolution magnetic reso-
resonance imaging of abducens nerve by 3D-CISS. Nippon 
surg 96:160–161, 2002
normal pontine cisternal segment of the abducens nerve, using 
three-dimensional constructive interference in the steady state 
MRI. Neuroradiology 41:384–386, 1999
resonance angiography in predicting neurovascular compression 
in patients with trigeminal neuralgia? A prospective, single-blind 
17. Rogers CL, Shetter AG, Ponce FA, et al: Gamma knife radio-
surgery for trigeminal neuralgia associated with multiple sclerosis. 
J Neurosurg 97:529–532, 2002
18. Ross JS, Masaryk TJ, Modic MT: Three-dimensional FLASH 
imaging: applications with gadolinium-DTPA. J Comput Assist 
Tomogr 13:547–552, 1989
cranial nerves using 3-dimensional constructive interference in 
steady state, 3-dimensional magnetization-prepared rapid gradient 
echo and T2-weighted 2-dimensional turbo spin echo magnetic 
resonance imaging sequences. J Neuroradiol 11:160–164, 
2001
lesions using six different high-resolution TI– and T2(∗)-weight-
results in patients with vascular compression of the trigeminal 
for recurrent trigeminal neuralgia. J Neurosurg 97:536–538, 
2002
relief of trigeminal neuralgia. J Miss State Med Assoc 43: 
205–207, 2002
flight MR angiography in trigeminal neuralgia on a 0.5-t system. 
nance imaging anatomy of the cisternal segment of the abducens 
nerve: Dorello’s canal and neurovascular relationships and land-
imal cisternal segment of the trochlear nerve: neurovascular 
primary trigeminal neuralgia using the Leksell Gamma unit. 

Address reprint requests to: Vasilios A. Zerris, M.D., M.P.H., 
M.M.Sc., Department of Neurosurgery, NEMC 178, 750 Washing-
ton Street, Boston, Massachusetts 02111. email:vaszerris@yahoo. 
com.