Endoscope-assisted Microvascular Decompression for Trigeminal Neuralgia: Technical Case Report

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Received, September 15, 2004.
Accepted, May 10, 2006.

OBJECTIVE: Microvascular decompression may fail to relieve trigeminal neuralgia because a compressing vessel at the root entry zone may be overlooked during surgery. Alternatively, effective decompression may not always be achieved with the visualization provided by the microscope alone. We theorized that the addition of an endoscope would improve the efficacy of microvascular decompression.

METHODS: We retrospectively reviewed microvascular decompression of the trigeminal nerve in 114 patients. Before closure, the endoscope was used to inspect the root entry zone. When visualization with the microscope was poor, the endoscope was used to identify an aberrant vessel and to perform or improve the subsequent decompression.

RESULTS: Of 114 patients who underwent microvascular decompression, 113 successfully underwent endoscopy. In 38 patients (33%), endoscopy revealed arteries that were poorly seen (25%) or not seen at all (8%) with the microscope. At a mean follow-up period of 29 months, the pain was completely relieved in 112 patients (99.1%), all of whom were off medication. Complications included trigeminal dysesthesias in nine patients and a wound infection, partial hearing loss, and complete hearing loss in one patient each. The overall complication rate was 9%.

CONCLUSION: Endoscopy is a simple and safe adjunct to microscopic exploration of the trigeminal nerve. The markedly improved visualization increases the likelihood of identifying the offending vessel and consequently of achieving satisfactory decompression of the nerve. Thus far, the success rate has been high, and the complication profile is comparable to that of other large series.

KEY WORDS: Endoscopy, Microvascular decompression, Trigeminal neuralgia

Neurosurgery 59[ONS Suppl 4]:ONS-489–ONS-490, 2006 DOI: 10.1227/01.NEU.0000232768.47615.82

Microvascular decompression (MVD) of the trigeminal nerve, as popularized by Janetta, is the most effective method of treating trigeminal neuralgia (17). However, in large series in which trigeminal neuralgia was managed by retrosigmoid MVD, the failure rate has ranged from 12 to 34% (3, 4, 6, 7, 11, 14, 16, 21). Because the wide availability of magnetic resonance imaging (MRI) has almost eliminated nonvascular causes of trigeminal neuralgia (e.g., tumor, multiple sclerosis) as reasons for failure, we hypothesized that most immediate failures reflect the failure to identify or adequately decompress a vessel compressing the trigeminal nerve at the root entry zone. Better visualization of the trigeminal nerve would likely reduce the number of negative explorations, increase the number of successful MVDs, and ultimately improve the success rate of the procedure. Therefore, this study was performed to document the use of endoscopy during MVD for the management of trigeminal neuralgia.

MATERIALS AND METHODS

The charts and clinical notes of all patients who underwent MVD between January 1994 and July 2002 by the senior author (CT) were reviewed retrospectively. There were 114 patients (66 men and 48 women); their ages ranged from 34 to 76 years (mean age, 54 yr). Their duration of symptoms ranged from 9 months to 9 years (mean duration, 2.8 yr).

As necessary, patients were contacted by telephone to obtain follow-up information. Outcomes were categorized into four groups: excellent (patients had no pain, were on no medication, and had no persistent side effects), good (patients had no pain, but experienced minor [nondisabling] surgical complications), fair (pain was well controlled with medication), and poor (patients had persistent neuralgia or no pain, but persistent debilitating side effects). Follow-up periods ranged from 9 months to 8 years (mean follow-up, 38 mo).

Surgical Technique

Patients with trigeminal neuralgia were managed by surgical exploration using a standard microscopic retrosigmoid approach. Patients were placed in the lateral decubitus or supine position with their head tilted as far away as the mobility of their neck permitted. Under general endotracheal anesthesia, a 1- to 2-cm retrosigmoid craniectomy was made just inferior to the junction of the transverse and sigmoid sinuses (*Fig. 1*). The dura was opened and reflected against the sinus. With standard microneurosurgical techniques, the trigeminal nerve was identified by gently retracting the cerebellum, releasing cerebrospinal fluid from the basal cisterns, and lysing the arachnoidal bands.

After the nerve was explored as thoroughly as possible with the microscope, a handheld 30-degree rigid endoscope was placed into the cerebellopontine angle to enhance the surgeon's view. The endoscope was advanced in a straight line toward the trigeminal nerve, keeping the shaft of the endoscope stabilized against the edge of the craniotomy or the venous sinus. The endoscope was rotated to the degree that the surgeon's wrist allowed to inspect the root entry zone. By aiming the 30-degree endoscope laterally, medially, superiorly, or inferiorly, a comprehensive view of the entire trigeminal nerve was obtained (*Fig. 2*). To obtain each view, the endoscope was adjusted by rotating the rod lens and camera to keep the image upright and the vector of the view ideal.

If the vessel was clearly visible with the microscope, the endoscope was used only to assess the competency of decompression at the end of the procedure. If the compressing vessel was seen better or only with the endoscope, MVD was performed under endoscopic control (*Figs. 3–5*).

MVD was achieved by placing a small Dacron patch (USCI, Billerica, MA) securely between the root entry zone of the nerve and the offending vessel. When possible, the patch was folded in half under tension so that it pushed the vessel away from the nerve.

When the microvascular decompression was performed under endoscopic control, the endoscope was carefully introduced into the posterior fossa alongside a small blunt suction

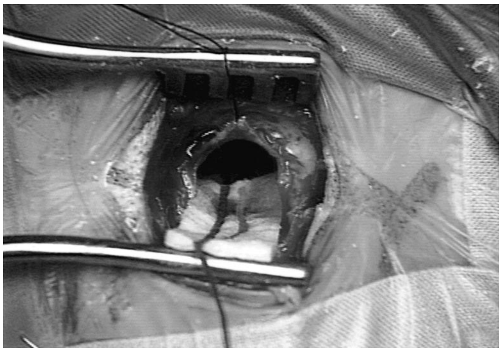

FIGURE 1. *Intraoperative photograph showing that a small standard craniectomy provides sufficient room for an endoscope and a working instrument.*

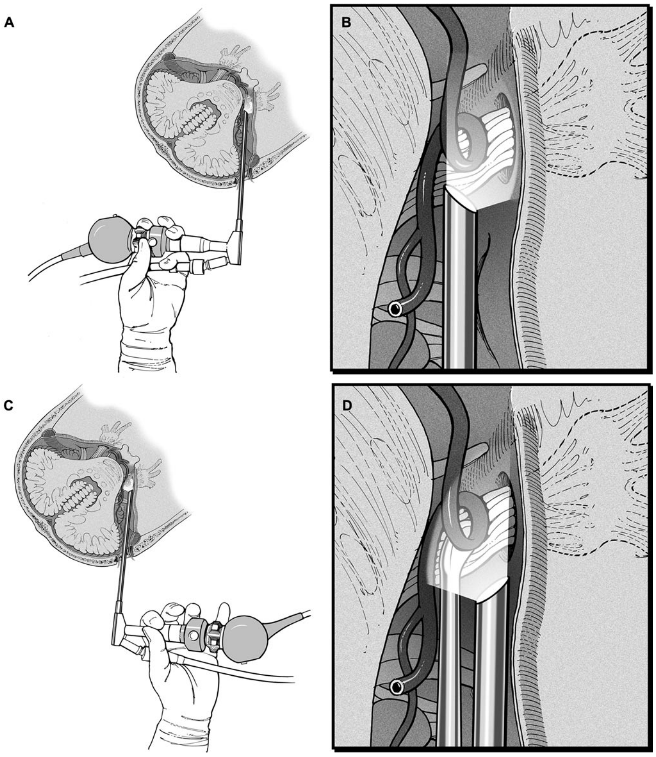

FIGURE 2. *A, illustration showing the endoscope held in the left hand with a 30-degree angle going toward Meckel's cave. B, close-up view of the endoscope looking out toward the distal trigeminal nerve. C, the endoscope and camera are rotated to keep the image upright while looking back toward the root entry zone. D, close-up view of the trigeminal nerve root entry zone. (Courtesy of Barrow Neurological Institute, Phoenix, AZ.)*

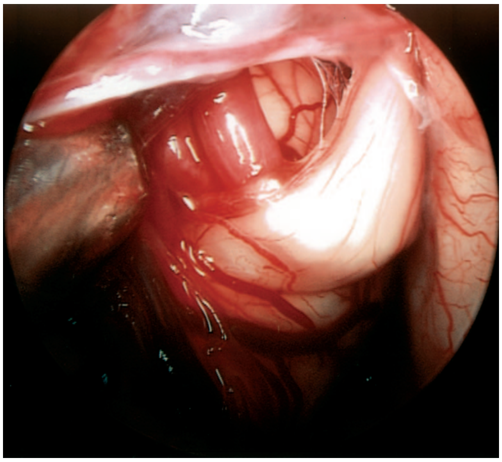

FIGURE 3. *Intraoperative photograph showing a 30-degree endoscopic view of the compressed root entry zone.*

or a small dissector. The instruments were maintained ahead of the endoscope so that they would be in view at all times, avoiding possible unseen collisions with delicate neurovascular structures. One-handed dissection and manipulation of the patch were performed with the endoscope in one hand and

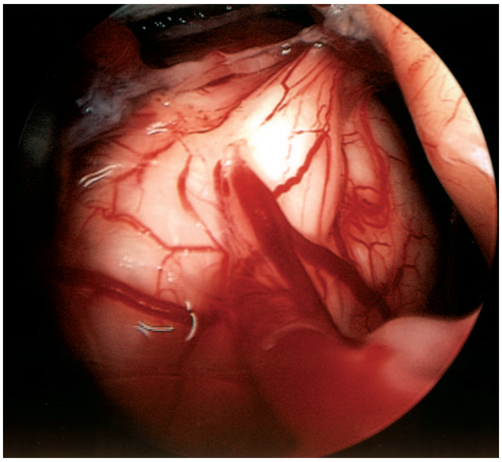

FIGURE 4. *Intraoperative photograph showing decompression completed with the microscope being inspected by endoscopy.*

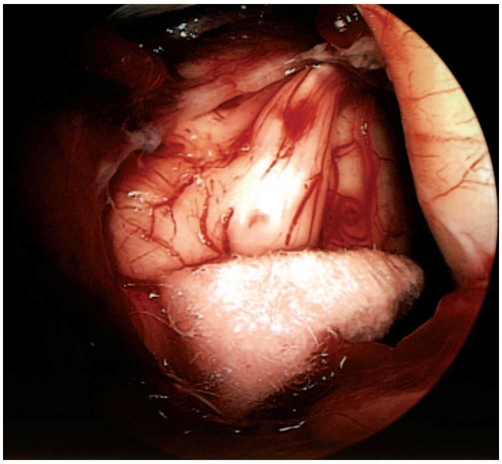

FIGURE 5. *Intraoperative photograph showing that a different vessel still lies knuckled against the root entry zone (30-degree endoscope). A second pledget completely decompresses the root entry zone.*

the operating instrument in the other. Drainage of spinal fluid normally made it possible to operate for brief periods without the aid of a suction in the nondominant hand. Closure was completed by standard techniques, including watertight dural closure, whenever possible.

RESULTS

One patient did not undergo an endoscope-assisted operation because of technical problems with the endoscope. This patient underwent a traditional MVD and had an excellent outcome. The other 113 patients underwent traditional microscope-assisted MVDs followed by endoscopic inspection and, as necessary, endoscope-assisted decompression.

Exploration was positive in all patients. At least one artery was implicated as the principal source of compression in all cases. Veins were spared even if venous deformation of the trigeminal nerve was seen. In 38 patients (33%), endoscopy revealed arterial compression that was poorly seen (25%) or not seen at all (8%) with the microscope. In nine of these cases (8%), the vessel compressing the trigeminal nerve was identified with the endoscope after no convincing vessel was identified using the microscope alone. In these nine cases, the vessel was located proximally in the groove between the root entry zone and the cerebellum. In 17 cases (15%), decompressions that were initially considered adequate using the microscope were subsequently found to be inadequate under endoscopic inspection. In each case, the operation was altered to take advantage of the superior visualization provided by the endoscope. Technically adequate decompressions were subsequently performed under endoscopic guidance in all 26 patients.

Trigeminal pain was relieved in 112 patients (99.1%) who were free of medication at the time of their follow-up evaluation. Complications included transient dysesthesias in the distribution of the trigeminal nerve in seven patients, transient hearing loss in one patient, and permanent hearing loss in one patient. In most patients who complained of dysesthesias, the condition was present at their 6-week follow-up visit. However, the complaint resolved in all patients by their 3-month follow-up visit. One patient with a wound infection required oral antibiotics. There were no cases of cerebellar dysfunction, cerebrospinal fluid leakage, or perioperative death. The overall complication rate was, therefore, 9%. According to our classification scheme, excellent outcomes were obtained in 103 patients (91%), good outcomes were obtained in nine patients (9%), and a poor outcome was obtained in one patient (0.9%), owing to his permanent hearing loss.

DISCUSSION

The two major deterrents to the selection of MVD for the treatment of trigeminal neuralgia are the inherent risks associated with posterior fossa craniectomy and the fear of a negative exploration. Despite advances in imaging, only direct inspection of the nerve root entry zone establishes the presence of compression (5, 18). The current gold standard is surgical exploration with an operating microscope. However, the microscopic view is limited to the line of sight between the craniectomy and the lateral surface of the nerve, and compression can occur anywhere around the circumference of the nerve or anywhere along its length (15). In contrast, all areas of the trigeminal nerve are easily accessible with the endoscope (10, 19).

In our series, 33% of patients would have had an inadequate or negative exploration, decompression, or both without the use of the endoscope. The most common location for a vessel to be missed was in the crease between the trigeminal nerve and the cerebellum. Lateral to medial visualization of this location is difficult to obtain because of the ridge formed by the cerebellum. More vigorous retraction would probably allow some vessels in this location to be seen. However, we intentionally used the endoscope to avoid such retraction. Cerebellar retraction is associated with many of the complications of this procedure, including hearing loss (9). Because we avoided such retraction, we cannot determine the percentage of vessels that would have been found with more vigorous microscopic exploration or whether additional complications would have followed from more vigorous exploration.

The use of the endoscope after MVD was completed yielded further benefit. It showed that the trigeminal nerve was still compressed or deformed even though the MVD had seemed adequate on microscopy. The microscope is still used to perform the initial decompression because it is easier for a single surgeon to work with both hands under the microscope. However, in our practice, we now consider the endoscope mandatory to evaluate the quality of an MVD. Once the surgeon is comfortable using the endoscope, MVD can be performed under endoscopic control as necessary.

Only a few other similar series have been reported. Using a similar technique, Jarrahy et al. (12) found that 14 out of 51 (28%) compressive vessels were only visible on endoscopy and that MVDs were inadequate in 21 patients (25%) after endoscopic review. El-Garem et al. (8) used the endoscope in 42 MVDs for the treatment of trigeminal neuralgia. Neurovascular conflicts were present in every case, but they made no comparisons with the microscope. Between their two series, King et al. (13) and Abdeen et al. (1) described 20 patients, but did not address the circumstances in which the endoscope was useful. Rak et al. (20) used an endoscope-assisted technique in 17 patients with trigeminal neuralgia. The endoscope was used to improve visualization of the trigeminal nerve complex in 11 cases, and part of the procedure was done under endoscopic control in six cases. They found the endoscope to be most useful for visualizing the distal part of the trigeminal nerve in Meckel's cave, where they used it to coagulate trigeminal veins. They reported that the endoscope was useful in all cases, and the rate of pain relief at a mean follow-up period of 29 months was 100% (20). Balansard et al. (2) had a lower complete pain relief rate of 69% and partial pain relief rate of 21%, but their patients also had a much longer period of trigeminal neuralgia before MVD (6 versus 2.8 yr) and, therefore, may represent a different population.

After MVD, 100% of our patients were found to have arterial compression at or near the root entry zone. The rate of arterial compression was high compared with other reports. Barker et al. (3) and Jannetta and Levy (11) report that a vessel of any size can be implicated as a cause of trigeminal neuralgia, and they have found that patients with venous compression are less likely to have good outcomes. Our results, therefore, suggest that arterial compression is the actual cause of trigeminal neuralgia in most cases.

Our overall complication rate of 9% was similar to that reported in other large series of nonendoscope-assisted MVDs (3, 17). Importantly, the addition of endoscopy did not increase the rate of infection or injure other cranial nerves. Our relatively high rate of troubling dysesthesias, all of which resolved within 6 months, may have been related to vigorous decompression of the nerve. There were no instances of direct trauma to the nerve caused by contact with the endoscope.

A number of technical issues related to the use of the endoscope have been raised. One of the most common concerns is the two-dimensional view that the endoscope provides. Undeniably, the learning curve for attaining the visuomotor skills necessary to work comfortably using a video image is steep. Although disorienting to the novice endoscopist, this theoretical limitation seldom presents much difficulty for most surgeons once they are familiar with the technique.

Whether more or less access is needed to use the endoscope is debated. One of the goals of using an endoscope is to reduce the cerebellar retraction needed to expose the full subarachnoid extent of the trigeminal nerve, thereby avoiding complications associated with retraction such as hearing loss, cerebellar swelling, and cerebellar infarction. In the "endoscope-assisted" surgical role, the instruments are introduced around the endoscope. Consequently, adequate exposure is needed to place the endoscope and to maneuver. Whether less retraction is required when using the endoscope to perform MVD compared with the usual no-retractor microscopic technique is debatable. At a minimum, the endoscopic technique is compatible with the smallest of craniectomies. In our experience, it has permitted the opening to be smaller and has required less retraction than the conventional technique.

This series is small compared with the large number of cases that have been performed microscopically. Furthermore, the follow-up period is still short. It is too early to determine the effect that the addition of endoscopy will have on long-term clinical outcomes in larger series. In our preliminary experience, however, endoscopy was a valuable adjunct both when adequate decompression was thought to have been performed and when no compression was visible with the microscope alone. Therefore, it should be considered a useful adjunct in all cases, regardless of whether a compressive vessel is identified during microscopic exploration.

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Acknowledgment

The first 67 patients in this study were separately reported as an abstract presented in oral form at the 2002 American Association of Neurological Surgeons annual meeting in Chicago, April 6–11, 2002.

COMMENTS

Teo et al. have described the usefulness of endoscope-assisted microsurgery in microvascular decompression of the trigeminal nerve. In 38 (33%) patients, endoscopy revealed arterial compression, which was seen poorly (25%) or not at all (8%) under the microscope. In 17 (15%) patients, decompression considered initially adequate under the microscope had to be revised after viewing under the endoscope. At the time of follow-up, 112 patients (99.1%) were free of the need to take medications for pain.

In my smaller series of endoscope-assisted microvascular decompression for trigeminal neuralgia, hemifacial spasm, and intractable tinnitus, I found the endoscope to be very useful (2). However, I am surprised that Teo et al. found arterial compression as the cause of all of their patients with trigeminal neuralgia. In my experience, as well as that of Jannetta and Levy (1), venous compression is an important cause of trigeminal neuralgia and may be the only finding in some patients.

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Teo et al. describe their findings (intra- and postoperative) in 113 patients who underwent endoscopic-assisted microvascular decompression for trigeminal neuralgia. The authors found that, in 38 (33%) patients, endoscopy revealed a compressive artery that was either poorly visualized (25%) or not visualized at all (8%) by the operating microscope. At the last follow-up examination (mean, 29 mo), 99% of patients had complete pain relief and were not taking medication. Their complication rate was 9%. They concluded that endoscopy is a safe and effective adjunct to microscopic microvascular decompression for trigeminal neuralgia.

This report adds to a rapidly growing body of literature describing the safe and successful use of the endoscope in a variety of central nervous system disorders. The authors provide an in-depth description of their technique. Ultimately, as the authors report, the potential advantages of this endoscope-assisted technique compared with microvascular decompression without endoscopic assistance will be best determined as the number of patients treated increases and long-term follow-up becomes available.

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