Acta Scientific NEUROLOGY

Volume 8 Issue 9 September 2025

Research Article

Current Status of Microvascular Decompression for Trigeminal Neuralgia in our Department

Keisuke Onoda*, Tomoyuki Naito, Akira Saitoh, Shuhei Yamasaki, Ryohei Sashida, Tomihiro Wakamiya, Masahiro Indou, Kimihiro Nakahara, Tatsuya Tanaka, Takashi Agari, Takashi Sugawara, Kazuaki Shimoji, Eiichi Suehiro, Hiroshi Itokawa and Akira Matsuno

Department of Neurosurgery, School of Medicine, International University of Health and Welfare, Narita Hospital, Narita, Japan

***Corresponding Author:** Keisuke Onoda; Department of Neurosurgery, School of Medicine, International University of Health and Welfare, Narita Hospital, Narita, Japan.

DOI: 10.31080/ASNE.2025.08.0858

Received: August 01, 2025

Published: August 19, 2025

Abstract

Microvascular decompression (MVD) has spread worldwide as a treatment for trigeminal neuralgia (TN) and is a standard surgical procedure. In our department, the number of such surgeries has been increasing, and we are one of the facilities in Japan that performs many of these procedures. In this report, we introduce the modifications and practical aspects of this surgery for TN. Magnetic resonance imaging (MRI) is useful as a preoperative examination, and three-dimensional magnetic resonance cisternogram/angiogram fusion images enable detailed and accurate visualization of the three-dimensional compression of nerves and blood vessels. Hearing loss is a potential surgical complication; however, we monitor the auditory brainstem responses intraoperatively as a preventive measure. To prevent cerebrospinal fluid leakage, we meticulously suture the dura mater and use fibrin glue to close the epidural space. Surgery is divided into transposition, which involves significantly moving blood vessels, and interposition, which involves the insertion of a prosthesis between the blood vessels and nerves. The choice between these two methods is made by selecting an appropriate approach based on the actual surgical field. Additionally, in cases with severe adhesions or no vascular compression, internal neurolysis involving a longitudinal incision of the epineurium of the trigeminal nerve has yielded favorable outcomes. The surgical results have shown no major complications, with more than 95% of patients experiencing symptom disappearance or improvement. Owing to the nature of MVD, which is intended to treat functional disorders, such as TN, a detailed preoperative evaluation, advanced techniques, and intraoperative monitoring are required before surgery. However, surgery is the fundamental treatment for this disorder and should be aggressively considered.

Keywords: Microvascular Decompression; Trigeminal Neuralgia; Three-Dimensional Magnetic Resonance Cisternogram; Angiogram Fusion Image

Abbreviations

3D-MRC/MRA: Three-Dimensional Magnetic Resonance Cisternogram/Angiogram; AICA: Anterior Inferior Cerebellar Artery; CSF: Cerebrospinal Fluid; MRI: Magnetic Resonance Imaging; MVD: Microvascular Decompression; SCA: Superior Cerebellar Artery; TN: Trigeminal Neuralgia

Introduction

Neurovascular compression syndrome was first reported by Dandy in 1934 [1], who suggested that trigeminal neuralgia (TN) was caused by direct vascular compression. Gardner and Miklos [2] were the first to report microvascular decompression (MVD) for TN in 1959. Further improvements were made and Jannetta [3] reported MVD for TN in 1967, after which the procedure spread worldwide and became the gold-standard technique. The number of surgeries performed in our department is increasing, and we now rank at the top in Japan. MVD has been used to treat TN, hemifacial spasm, and glossopharyngeal neuralgia. In this article, we focus on MVD for TN treatment in our department and describe the surgical procedures.

Current Method and Discussion

Surgical indication

Currently, there are no clearly defined surgical indications for TN; however, typical clinical symptoms and drug-resistant TN are considered indications [4]. Surgery in elderly adults with TN is controversial from the perspective of invasive procedures. However, in elderly adults, TN can cause difficulty in eating, rapid weight loss, and a significant decline in activities of daily living. Therefore, we aggressively consider surgery based on the patient's health status and underlying preoperative diseases [5,6].

Preoperative evaluation

A preoperative examination is crucial for this surgery. If we can accurately determine the anatomical relationship between the trigeminal nerve and responsible blood vessels, we can perform safer and more precise surgeries. We use magnetic resonance imaging (MRI) to obtain detailed information on compression of the trigeminal nerve by the responsible blood vessels (Figure 1). Traditionally, various MRI techniques have been used for preoperative evaluation, each with its own advantages and disadvantages [7,8]. However, MRI is a two-dimensional techniques, and there are limitations to capturing detailed compression information. We have reported the evaluation and usefulness of three-dimensional MR cisternogram/angiogram (3D-MRC/MRA) fusion images, which enable the accurate three-dimensional assessment of vascular compression of the trigeminal nerve and allow for surgical simulation [9,10]. Furthermore, this examination is extremely useful because it enables the evaluation of not only the responsible vessel but also the deformation of the trigeminal nerve caused by compression [9,10]. This method is also used in postoperative evaluation, enabling confirmation of the movement of the responsible vessel and improvement of trigeminal nerve deformation. In addition, because anatomical information on the transverse and sigmoid sinuses is necessary at the time of craniotomy, we use MR venography to obtain preoperative information on the degree of development and course.

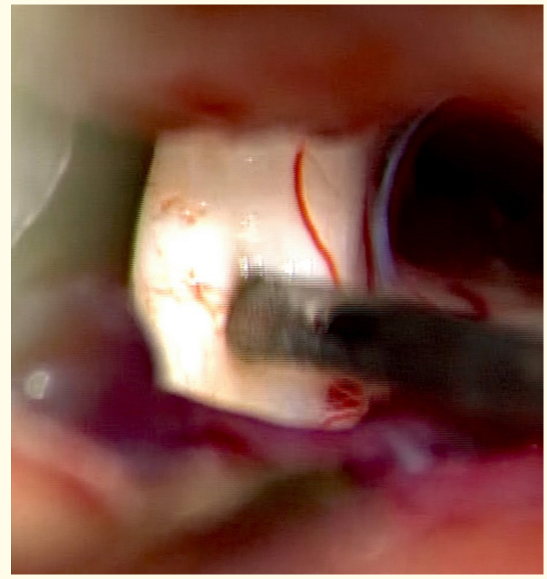

Figure 1: (A) Preoperative three-dimensional magnetic resonance cisternography/angiography fusion imaging showed severe compression of the right trigeminal nerve (arrow) by the superior cerebellar artery (arrowhead). (B) Postoperative findings showed sufficient decompression using transposition.

Surgery

To prevent postoperative complications such as hearing loss, the auditory brainstem response is continuously monitored intraoperatively.

Position

The surgery is performed with the patient in the lateral decubitus position. The head is rotated toward the healthy side and slightly flexed forward to maximize the surgical space in the posterior cranial fossa.

Skin incision

A 5- to 6-cm linear skin incision is made across the angle between the transverse and sigmoid sinuses. The incision is spread out using a retractor, the muscle is peeled off, and the skull is exposed. The lateral side of the mastoid process is then exposed to the lateral margin.

Craniotomy

The most used landmark for craniotomy is the asterion; however, we use the digastric groove in our department. The position of the asterion is known to vary among individuals [11]; however, the digastric groove shows little individual variation, and the sigmoid sinus can be identified in almost all cases immediately below it. We drill a burr hole in the digastric groove, capture the sigmoid sinus, and minimize the compression of the cerebellum by drilling the skull until the lateral ends of the sigmoid and transverse sinuses are exposed. When the mastoid air cells are opened, they are packed with bone wax to prevent the entry of saline and blood.

Dura incision

The surgical approach is made from the angle formed by the transverse and sigmoid sinuses; therefore, the dura mater is incised in an arcuate manner to ensure the best possible visibility. Care must be taken to ensure that the dura mater incision is not too narrow as this would make it difficult to apply the retractor.

Intradural manipulation

The following procedures are performed under a surgical microscope. First, the surgeon moves to the patient's head, focuses the microscope on the lateral cerebellar medullary cistern, then advances deeper and fixes it. The arachnoid membrane forming the cerebral cistern is incised and cerebrospinal fluid (CSF) is aspirated to slack the cerebellum, making it easier to operate safely. After the cerebellum slackens, the surgeon moves to the patient. A horizontal fissure is observed on the cephalic side of the eighth cranial nerve. The trigeminal nerve can be reached by peeling and incising the fissure and advancing deeper. The superior petrosal vein is identified and the surrounding arachnoid membrane is incised and peeled away as much as possible to free it and prevent damage to the vein. At this stage, cerebellar compression is typically unnecessary. During the procedure, we always pay attention to the auditory brainstem responses; if the fifth wave persists for more than 1.0 ms, we interrupt the surgical procedure and wait for recovery [12]. The arachnoid membrane surrounding the trigeminal nerve is incised, the entire length of the trigeminal nerve is visualized, and the vessel compressing the nerve is identified. During this procedure, the microscope's focus is adjusted to the depth of the trigeminal nerve; however, care must be taken not to damage the superior petrosal vein or the seventh and eighth cranial nerves located in front of the focus. The seventh and eighth cranial nerves are protected by covering them with a cotton pad and manipulating them accordingly. The most common surgical complication is hearing loss [13], which is thought to be caused by stretching of the eighth cranial nerve during surgery. We prevent this stretching by not dissecting the caudal arachnoid membrane of the eighth cranial nerve. We have not experienced any hearing loss since we started using this method. When the vessel responsible is the superior cerebellar artery (SCA), compression from the cranial direction of the trigeminal nerve is common, while in the case of the anterior inferior cerebellar artery (AICA) and vertebral artery, compression from the caudal direction is common [14]. When the responsible vessel is the SCA, it often forms a loop that causes compression. When dissecting and moving away from the trigeminal nerve, the vessel kinks; therefore, it should be dissected for as long as possible to prevent cerebral infarction. Particular caution is required when moving blood vessels in severe arteriosclerosis, because damage to the vessel wall may cause blood clot formation. Although there is a possibility of damage to the penetrating branches of the brainstem due to SCA translocation, the penetrating branches of the brainstem originating from the SCA are longer than those of the AICA. Therefore, damage is unlikely [14], but careful manipulation is required. The trochlear nerve runs along the edge of the cerebellar tentorium, and damage to it can cause double vision; therefore, incisions in the arachnoid membrane between the cerebellar tentorium and the upper surface of the cerebellum must be performed with caution. After separating the nerves and blood vessels, we roll Teflon felt into a rope-like shape, wrap it around the target blood vessel, pull it toward the cerebellar tentorium, and stabilize it with fibrin glue (transposition) [15,16] (Figure 2). Transposition allows for significant displacement of blood vessels, enabling complete decompression without direct contact between the nerve and the Teflon felt, which is considered useful for preventing recurrence. Furthermore, our department also employs a method known as the "hanging method," in which the responsible vessel is moved and fixed by hooking it onto the superior petrosal vein, which runs nearby [17]. This method utilizes the existing anatomical structures and enables rational and effective decompression. In some cases, it is impossible to move the blood vessel because of the course or rigidity of its wall. In such cases, a Teflon felt prosthesis is inserted between the brainstem and the responsible blood vessel to provide decompression (interposition) [16]. After

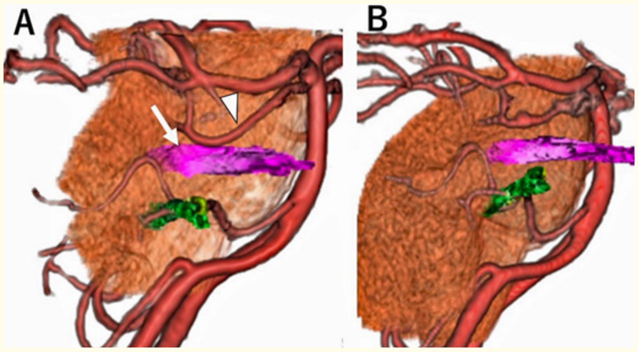

Figure 2: Surgical findings. (A) Pre-decompression and (B) post-decompression.
A: The trigeminal nerve (arrow) was severely compressed by the superior cerebellar artery (arrowhead).
B: The superior cerebellar artery is significantly transposed, resulting in successful nerve decompression.

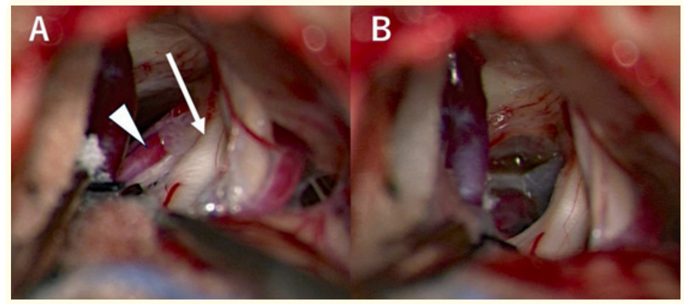

Figure 3: Surgical findings. Internal neurolysis involves cutting the trigeminal nerve epineurium in 3–4 sites along the longitudinal axis of the trigeminal nerve.

surgery, adhesions around the nerves may cause recurrence, and so it must be ensured that the prosthesis does not come into direct contact with the nerves. There have also been reports of veins being responsible for TN. Since veins have many branches extending to the brainstem and are difficult to move, careful dissection is required to prevent damage to the brainstem and nerves. Finally, in cases where there is no vascular compression, nerve twisting and deformation may also cause symptoms, and adhesion separation is performed to improve nerve deformation. Recently, the effectiveness of internal neurolysis, which involves dividing the trigeminal nerve longitudinally, has been reported in cases that are difficult to treat, such as those without vascular compression or with severe adhesions [18,19] (Figure 3). This is theorized to suppress abnormal nerve conduction [18], but the exact mechanism remains unclear. In our department, we perform internal neurolysis in cases of severe adhesions without vascular compression, which are considered to be at risk of recurrence, and have reported favorable results [20]. Internal neurolysis involves making three to four incisions along the longitudinal axis of the trigeminal nerve's epineurium [20]. Importantly, this method is associated with a low incidence of postoperative facial numbness. We speculate that this is due to a reduction in intratrigeminal pressure; however, further investigation is required to confirm this hypothesis.

Duraplasty and cranioplasty

We suture the dura mater tightly after surgery to prevent CSF leakage and then place Duragen (Integra Life Sciences, Princeton, NJ) on the epidural space. When mastoid air cells are exposed, they are packed with adipose tissue after the removal of bone wax. To date, no CSF leakage has been observed using this method. We do not use autologous bone but instead perform cranial reconstruction using a 4×5 cm titanium plate, followed by meticulous suturing of the muscle layer, subcutaneous tissue, and skin to complete the surgery. No subcutaneous drains are left in place.

Postoperative Course

Patients can walk freely without restrictions on the day after surgery and are discharged from the hospital approximately 7–8 days after surgery.

Surgical Results

At present, no complications such as hearing loss, cerebral infarction, infection, or cerebral hemorrhage have been observed. In over 95% of cases, symptoms disappear or improve, yielding excellent results.

Conclusion

Herein, we report the current status of microvascular decompression for TN in our department. MVD is an essential and useful treatment that eliminates the cause; however, it must be performed reliably and safely. 3D-MRC/MRA fusion images are extremely useful in planning surgery. TN significantly impairs activities of daily living not only in younger patients but also in elderly people; therefore, surgical treatment should be aggressively considered.

Acknowledgements

We would like to thank Editage (www.editage.jp) for English language editing.

Conflict of Interest

The authors declare that they have no conflict of interest.

Bibliography

1. Dandy WE. "Concerning the cause of trigeminal neuralgia". *American Journal of Surgery* 24 (1934): 447-455.
2. Gardner WJ., *et al*. "Response of trigeminal neuralgia to "decompression" of sensory root. Discussion of cause of trigeminal neuralgia". *Journal of the American Medical Association* 170 (1959): 1773-1776.
3. Jannetta PJ. "Arterial compression of the trigeminal nerve at the pons in patients with trigeminal neuralgia". *Journal of Neurosurgery* 26 (1967): 159-162.
4. Franzini A., *et al*. "The neurosurgical treatment of craniofacial pain syndromes: current surgical indications and techniques". *Neurological Sciences* 40 (2019): 159-168.
5. Onoda K*., et al.* "Microvascular decompression for trigeminal neuralgia in very elderly patients". *Acta Scientific Neurology* 7.6 (2024): 21-24.
6. Sun J., *et al*. "A meta-analysis of the effectiveness and safety of microvascular decompression in elderly patients with trigeminal neuralgia". *Journal of Clinical Neuroscience* 99 (2022): 22-34.
7. Hughes MA., *et al*. "MRI of the trigeminal nerve in patients with trigeminal neuralgia secondary to vascular compression". *American Journal of Roentgenology* 206 (2016): 595-600.
8. Seeburg DP., *et al*. "The role of imaging for trigeminal neuralgia: a segmental approach to high-resolution MRI". *Neurosurgery Clinics of North America* 27 (2016): 315-326.
9. Satoh T., *et al*. "Preoperative simulation for microvascular decompression in patients with idiopathic trigeminal neuralgia: visualization with three-dimensional magnetic resonance cisternogram and angiogram fusion imaging". *Neurosurgery* 60 (2007): 104-113; discussion 113-114.
10. Satoh T., *et al*. "Severity analysis of neurovascular contact in patients with trigeminal neuralgia: assessment with the inner view of the 3D MR cisternogram and angiogram fusion imaging". *American Journal of Neuroradiology* 30 (2009): 603-607.
11. Hamasaki T., *et al*. "A 3-dimensional computed tomographic procedure for planning retrosigmoid craniotomy". *Neurosurgery* 64 (2009): 241-245.
12. Nishihara K., *et al*. "[Importance of intraoperative monitoring of ABR and compound action potential of the eighth cranial nerve during microvascular decompression surgery]". *No Shinkei Geka* 14 (1986): 509-518.
13. Sindou M. "Operative strategies for minimizing hearing loss associated with microvascular decompression for trigeminal neuralgia". *World Neurosurgery* 74 (2010): 111-112.
14. Bick SKB., *et al*. "Surgical treatment of trigeminal neuralgia". *Neurosurgery Clinics of North America* 28 (2017): 429-438.
15. Amagasaki K., *et al*. "Macrovascular decompression with the transposition method using Teflon sling for trigeminal neuralgia caused by the vertebrobasilar artery". *World Neurosurgery* 167 (2022): e1395-e1401.
16. Uhl C., *et al*. "Transposition versus interposition method in microvascular decompression for trigeminal neuralgia: midterm analysis of both techniques in a single-center study". *Journal of Neurosurgery* 140.6 (2024): 1777-1784.
17. Onoda K., *et al*. "The hanging technique using the superior petrosal vein in surgical transposition for trigeminal neuralgia". *Interdisciplinary Neurosurgery* 22 (2020): 100795.
18. Ko AL., *et al*. "Long-term efficacy and safety of internal neurolysis for trigeminal neuralgia without neurovascular compression". *Journal of Neurosurgery* 122 (2015): 1048-1057.
19. Lavergne P., *et al*. "Internal neurolysis for trigeminal neuralgia: technical nuances and a single-institution experience". *World Neurosurgery* 184 (2024): e9-e16.
20. Onoda K., *et al*. "Efficacy of internal neurolysis for atypical facial pain". *Acta Scientific Neurology* 7.2 (2024): 35-40.