Microvascular Decompression for Trigeminal Neuralgia: Technical Refinement for Complication Avoidance

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BACKGROUND: **Microvascular decompression (MVD) represents the most effective and safe surgical option for the treatment of trigeminal neuralgia since it was first popularized by Jannetta 50 years ago. Despite several advances, complications such as cerebellar and vascular injury, hearing loss, muscular atrophy, cerebrospinal fluid (CSF) leak, postoperative cutaneous pain, and sensory disturbances still occur and may negatively affect the outcome. We propose some technical nuances of the surgical procedure that were used in our recent series.**

METHODS: **We used a novel hockey stick—shaped retromastoid skin incision, preserving the major nerves of the occipital and temporal areas. Microsurgical steps were performed without the use of retractors. CSF leakage was prevented with a watertight dural closure and multilayer osteodural reconstruction.**

RESULTS: **The refined surgical steps were perfected in the last consecutive 15 cases of our series. In these cases we did not record any cutaneous pain, sensory disturbances, or CSF leakage. The average diameter of the craniectomy was 18 mm. No patient reported major complications related to the intradural microsurgical maneuvers. In all cases the neurovascular conflict was found and solved with a good outcome in terms of pain disappearance.**

CONCLUSIONS: **Our minimally invasive approach was demonstrated to guarantee an optimal exposure of the cerebellopontine angle and minimize the rate of complications related to skin incision and muscular dissection, microsurgical steps, and closure.**

Key words
- Complications
- Cutaneous sensory disturbances
- Microvascular decompression
- Minimally invasive surgery
- Retrosigmoid approach

Abbreviations and Acronyms
CPA: Cerebellopontine angle
CSF: Cerebrospinal fluid
EOP: External occipital protuberance
GAN: Greater auricular nerve
GON: Greater occipital nerve
LON: Lesser occipital nerve
MVD: Microvascular decompression
SCM: Sternocleidomastoid muscle
SPV: Superior petrosal vein

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INTRODUCTION

Trigeminal neuralgia represents one of the most disabling diseases involving human beings. Since the first procedure performed 50 years ago by Jannetta,[1] microvascular decompression (MVD) remains an effective and safe treatment characterized, in the majority of cases, by long-lasting clinical benefits.

During the past 50 years, the surgical technique has undergone several variations and refinements by the same pioneer[2-4] and other authors[5-8] in order to minimize morbidity. Nevertheless, minor and major postoperative complications continue to be reported in the literature: muscular atrophy, local cutaneus occipital and temporal pain, numbness, paresthesias, cerebellar injury, hearing loss, and cerebrospinal fluid (CSF) leak.[3,5-13]

Since MVD has to be considered a functional treatment, we need to make an even greater effort to achieve the lowest rate of postoperative morbidity. In our experience, some key surgical steps appear essential to avoid the previously mentioned complications, such as skin incision, muscles dissection, preservation of auricular and occipital nerves, dural opening/closure, retractorless cerebellopontine angle (CPA) exposure, superior petrosal vein (SPV) preservation, and careful handling of the eighth cranial nerve and its vascularization.

Here we describe technical refinements of the widely used approach for MVD in trigeminal neuralgia, perfected in the last consecutive 15 patients in a series of 173 subjects operated on in the past 10 years.

DESCRIPTION OF SURGICAL TECHNIQUE

Patient Positioning

Following general anesthesia and orotracheal intubation, the patient is placed in lateral position. The hips and knees are placed in flexion. The ipsilateral shoulder is placed away from the surgical field to allow major comfort into the surgical field. The head is fixed to a 3-pin Mayfield-Kees head holder and turned 45° contralaterally with slight extension preserving venous drainage. The malar bone is in the highest portion, and the vertex is kept parallel with the floor.

Anatomic Considerations for Skin Incision and Sensory Nerves Preservation

Greater Occipital Nerve. The greater occipital nerve (GON) originates from the medial branch of the dorsal ramus of the C2 nerve and may intercommunicate with branches from the dorsal ramus of C3 nerve. The GON lies 4 cm lateral to the inion. It passes inferior to the base of the suboccipital triangle formed by the rectus capitis major, superior capitis oblique, and inferior capitis oblique[14] and finally ascends to pierce the semispinalis capitis muscle, on average 2 cm superior to the intermastoid line and trapezius. It provides cutaneous sensation to the medial posterior neck and scalp up to the coronal suture.

Lesser Occipital Nerve. The lesser occipital nerve (LON) originates from the lateral branch of the dorsal rami of spinal nerves C2 and C3 and courses to the occipital area parallel with the posterior margin of the sternocleidomastoid muscle (SCM).[15] This nerve is located circa 7 cm lateral to the external occipital protuberance (EOP) lying at a mean of 3 cm medial to the tip of the mastoid process.[16] Near the cranium it perforates the deep fascia and continues superiorly over the occiput, where it communicates with the GON medially. It gives sensory and motor rami and provides cutaneous sensation to the occipital, mastoid, and temporal regions.

Greater Auricular Nerve. The greater auricular nerve (GAN) arises from the ventral rami of spinal nerves C2 and C3. It ascends on either the anterior or posterior external surface of the sternocleidomastoid muscle SCM.[16] The mastoid branch of the GAN is detected at a mean of 9 cm lateral to the EOP, and the main trunk is found lying 1 cm superior to the mastoid tip. It is a sensory nerve, mainly distributed to the auricle and parotid regions, but it may have a mastoid branch that communicates with the LON posteriorly.

Skin Incision

A novel hockey stick–shaped 25 × 25 mm retromastoid skin incision is performed considering the following anatomic landmarks (**Figure 1**): 1) the superior and inferior aspects of the incision are made, respectively, slightly superior to the superior nuchal line and 2 cm superior to the mastoid tip to preserve the GAN; 2) the most medial aspect of the incision is approximately 7 cm lateral to the EOP, avoiding LON injuries; 3) the incision is relatively far from the GON branches. The skin is incised deeply, down to the muscle fascia. We perform a smooth muscle dissection, never using the monopolar cautery, in order to reduce the risk that the heat dispersion could still injure the nerves spared by the incision and/or cause muscular atrophy. A self-retaining retractor with blunt tips is used to gently retract the skin and muscles.

Craniectomy

A high-speed drill is used to perform a single burr hole, positioned inferiorly and medially to the transverse-sigmoid sinuses junction. Next, a craniectomy of an average 18 mm (range 17–20 mm) is performed with bone rongeurs (**Figure 2**). We try to avoid opening the mastoid cells, minimizing the risk of CSF fistula or infections. Should the mastoid air cells be opened, they must be meticulously closed with bone wax. The superior aspect of the craniectomy faces the transverse-sigmoid junction.

Dura Opening

The dura mater is opened in a curvilinear fashion, with the base reflected toward the sigmoid sinus, and it is tacked on the margin of the craniectomy, covered by wet cottonoids. This is the best opening to maximize the CPA exposure and facilitate a watertight closure.

Microsurgical Steps

The microsurgical steps of the operation do not differ from other technique description already reported, except for some authors' personal tips.

The lateral position is useful to access the CPA cistern. Differently from other experiences,[8] we never use a lumbar drain. Using a microincision of the arachnoid and patiently waiting for CSF drain, we usually obtain a progressive and sufficient release. In such a way, the tension of infratentorial space decreases and the cerebellum falls away inferiorly and posteriorly from the petrotentorial corridor, allowing the maximal visualization and the minimal traction of the seventh to eighth cranial nerve complex.[13] We perform this step avoiding the use of cerebellar retractors. During the procedure the cerebellum is gently retracted by using the suction cannula.

The petrotentorial junction and superior petrosal vein (SPV) are identified. Generally, we do not divide the SPV unless we are obliged by an inadvertent rupture or in case one of its branches is responsible for the neurovascular conflict.

At this point, angling the microscope a few grades superiorly and medially, the trigeminal nerve is exposed. Proceeding deeper into the CPA, the trigeminal nerve is inspected along its course from the brainstem root entry zone to the distal portion. A complete arachnoidal dissection is done. Sometimes, the nerve compression is distal and may be hidden by the arachnoid or trigeminal tuberculum. In this case the endoscopic-assisted procedure is quite useful (**Figure 3** and **Video 1**). We generally use a rigid endoscope with a 0- or 30-degree lens (Karl Storz, Tuttlingen, Germany).

Video

Video available at WORLDNEUROSURGERY.org

We use patches of autologous material (muscle) for neurovascular decompression.