



Original Article

# Endoscopy-Assisted Microvascular Decompression for Trigeminal Neuralgia: The Prognostic Impact of Interposing Material

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**OBJECTIVE:** Trigeminal neuralgia is a disorder associated with severe episodes of lancinating pain in the distribution of trigeminal nerve. The majority of these patients eventually requires surgical management to achieve remission of symptoms. Microvascular decompression addresses the root cause of the disease and is more effective than ablative procedures at preventing recurrence of symptoms. However, several long-term follow-up studies have disclosed that the efficacy of the procedure gradually decreases over time and have related recurrence to some clinical variables. Our objective is to study the impact of the type of interposing materials used for decompression on long-term success rate.

**MATERIALS and METHODS:** We conducted a retrospective chart review of 65 patients with trigeminal neuralgia operated between 2007 and 2010 in an otology/base of skull tertiary referral center. Endoscopy-assisted microvascular decompression was used for all patients. Three types of interposing material were used: Teflon in 30 patients (Group I); muscle in 19 patients (Group II); and a combination of both in 16 patients (Group III). The minimum follow-up period was 3 years.

**RESULTS:** In total, 17 (26.1%) of the 65 patients had recurrence of their symptoms. Average time for recurrence was 7.82+/-4.31 months; 95% of recurrences appeared within the first year. Recurrence rate was lower in Group II (5.2%) as compared to Group I (40%) and Group III (23%), and the difference was statistically significant ( $p \leq 0.05$ ).

**CONCLUSION:** Microvascular decompression with interposition of a muscle pad carries a lower recurrence rate as compared to interposition of Teflon alone or in combination with muscle.

**KEY WORDS:** Trigeminal neuralgia, retrosigmoid approach, microvascular decompression, endoscopy

## INTRODUCTION

Trigeminal neuralgia (TN) is a disorder associated with severe episodes of lancinating pain in the distribution of trigeminal nerve. The onset of the attacks, with a duration of a few seconds up to a minute, can be spontaneous or triggered by common daily activities, such as eating, speaking, or touching the skin. Patients with TN live in fear of unpredictable painful attacks, which may lead to sleep deprivation and life-threatening malnutrition. Furthermore, this condition can lead to irritability, severe anticipatory anxiety, and depression<sup>[1-6]</sup>.

The root cause of idiopathic TN is compression of the trigeminal nerve by an adjacent vessel.

Although several drugs have been introduced in the treatment of TN, many patients still require surgery because of resistance or drug intolerance.

Surgical options for management include ablative procedures (e.g., radiosurgery, percutaneous radiofrequency lesioning, balloon compression, glycerol rhizolysis, etc.) and microvascular decompression (MVD). Ablative procedures fail to address the root cause of the disorder and are less effective at preventing recurrence of symptoms over the long term than MVD<sup>[4-14]</sup>.

Microvascular decompression is the sole procedure with the highest likelihood of providing a permanent cure for TN without risk of injury to the trigeminal nerve; the intention of MVD is to pad the contact of an irritating vessel with the trigeminal nerve by interposing an isolating material between them. Although Teflon is the most used material nowadays<sup>[15-19]</sup>, a variety of other isolating materials have been used; these include muscle, fascia, Gelfoam, Ivalon sponges, and cotton gauze<sup>[20-25]</sup>.

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The major concern of MVD for TN is long-term recurrence, and several long-term follow-up studies have disclosed that the efficacy of MVD for TN gradually decreases over time because of recurrence [5, 26, 27].

The purpose of this study is to report our surgical experience with TN and to discuss the causes of recurrent TN, especially the impact of the surgical technique and the isolating material on the recurrence of neuralgia after MVD.

### MATERIALS and METHODS

This retrospective study was conducted in a neurotology base of skull tertiary care center to compare use of Teflon versus muscle versus a combination of both for microvascular decompression (MVD) in patients with refractory idiopathic trigeminal neuralgia (TN). Medical records from 2007 to 2010 of all patients who had received MVD for TN were reviewed to ensure at least 3 years of follow-up until 2013.

For all patients, data collected included demographics (sex, age), surgical indications, previous interventions, surgical technique, type of material used for decompression, postoperative complications, and the duration from being free of pain to recurrence. Cases with incomplete data were excluded. Patients with atypical neuralgia, secondary neuralgia, previous surgery, radiosurgery, or thermo-coagulation were excluded from the study. Only patients who underwent MVD using muscle or Teflon were included in this study. Some patients underwent sling technique; all of these patients were excluded.

All treated patients were initially diagnosed by the neurology department and referred to us for surgical management. All patients underwent comprehensive trials of medical therapy.

Indications for surgery included failure of pharmacologic treatment to provide significant pain relief or significant adverse effects from medication. Failure of medical therapy was defined as persistent disabling pain lasting a minimum of 1 month since initiation of the prior therapy.

All patients were examined preoperatively by 3-dimensional Fourier transform MRI (3DFT-MRI) with hyper-T2 sequences (constructive interference in study state; CISS, Siemens®, Erlangen, Germany), post-contrast T1 sequences (Turbo Flash), TOF (time of flight) sequences, and fluid-attenuated inversion recovery (FLAIR) sequences to first determine the presence of a neurovascular conflict and its location (Figure 1) and then to rule out any differential diagnosis. The combination of clinical symptoms with the diligent lecture of radiological exam led to proposal to the patient for an MVD procedure with planned decompression strategy.

Surgery was performed with informed consent, and different surgical alternatives were explained to the patients. Our procedure of choice was endoscope-assisted microvascular decompression procedure, in which the trigeminal nerve in the cerebellopontine angle (CPA) is approached via a minimal retrosigmoid approach through a small craniotomy, about 2 cm in diameter. The CPA is explored using a 30°-angled endoscope, which allows clear visualization of the whole trigeminal nerve region and a precise mapping of the site and the course of the offending vessel(s), minimizing missing any offending vessel and extensive retraction and dissection in the CPA (Figure 2). The procedure itself is carried out mixing the use of endoscope and microscope.

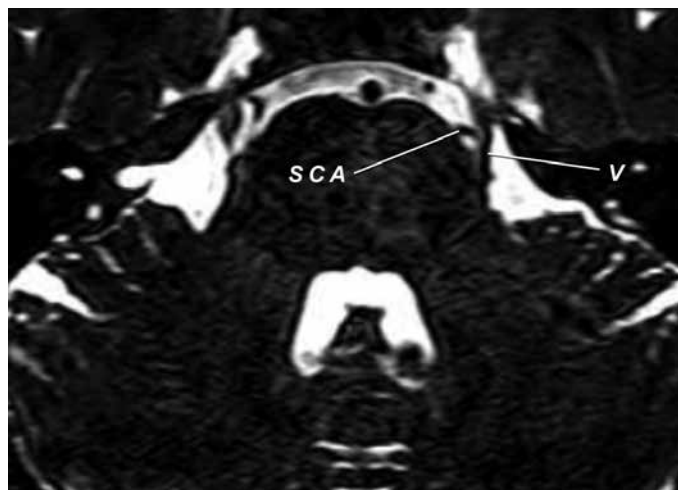


Figure 1. Clinico-demographic data of patients with postoperative recurrent trigeminal neuralgia as compared to those without recurrence

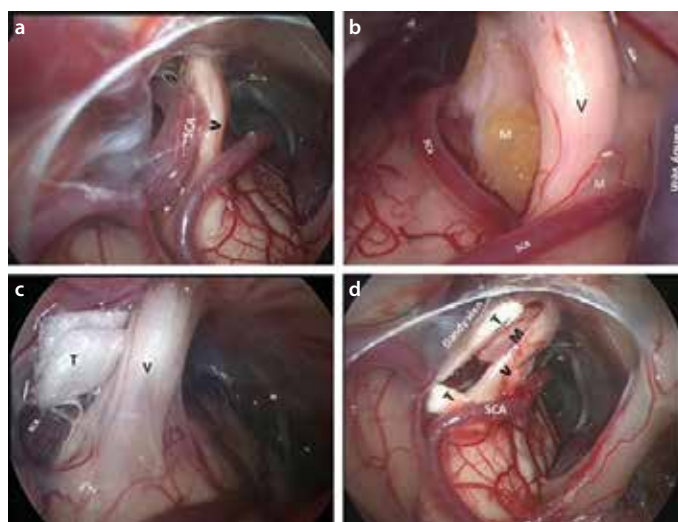


Figure 2. a-d. Right CPA endoscopy showing a type 3 conflict between the superior cerebellar artery (SCA) and the trigeminal nerve (V) (a); left CPA microscopic view, type III conflict between the SCA and V with muscle pad (M) interposition (b); right CPA endoscopy, type I conflict between SCA and the V with Teflon prosthesis (T) interposition (c); right CPA endoscopy, type 2 conflict between the Dandy vein and SCA and V with combined muscle (M) and Teflon (T) interposition (d)

We classified neurovascular conflict into one of the following:

1. **Simple contact:** The conflict is caused by an arterial loop, most of the time the superior cerebellar artery (SCA), and a single point of contact with the nerve.
2. **Multiple contacts:** The conflict includes different points of contact by several arterial loops, most of the time the SCA, around the nerve.
3. **Nutcracker type of contact:** The conflict includes 1 or more offending vessels above and below the nerve entangled between them.
4. **Vein contact:** The most common offending structure is the Dandy vein or an inconstant and aberrant petrous vein.

At the initial surgery, whatever the location or type of neurovascular conflict, MVD was achieved after mobilization of the vascular

structure by interposing an isolating material between the trigeminal nerve and the offending vessel(s). We used, as isolating material, either Teflon or muscle tissue harvested from the surgical field, or a combination of both. In the latter technique, we put a muscle pad between the nerve and the interposing Teflon felt in a way to prevent contact between the Teflon felt and the nerve.

Criteria for improvement included a reduction in both the frequency and severity of pain attacks and in the absence of neuralgia-specific pain medications. Severity of attacks was reported in the medical charts using numerical pain scores of 0-10, in which 0 indicated no pain and 10 corresponded to the worst pain imaginable. On a monthly basis, the frequency of attacks and the mean numerical pain score were reported in the medical chart and used to assess outcome.

Good response was referred to as more than a 50% reduction in the frequency and severity of attacks. No response or less than a 50% reduction in the frequency and severity of attacks was referred to as a treatment failure. Patients who experienced treatment failure after a time of good response were considered to have recurrence. For simplicity of analysis, only data indicating the failure of surgery and the time for failure were considered as outcome measures.

### Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) software (IBM SPSS Statistics, IBM Corporation; Chicago, IL, USA). Following testing for homogeneity of variance, parametric statistics were used, including one-way analysis of variance (ANOVA) for comparison of all groups on all interval-level measures, with pair-wise comparisons by post hoc analysis using the least significant difference (LSD) test. Criterion for statistical significance was set at  $p \leq 0.05$ .

### RESULTS

Of the 97 retrosigmoid MVD operations done for TN during the study period, 65 met our inclusion criteria (65 patients) and were reviewed for the current retrospective analysis. Thirteen patients were excluded because of a history surgical or radiosurgical intervention, 10 because of use of sling technique for MVD, 6 because of the effect of lost of follow-up, and 3 due to insufficient data.

The study group consisted of 65 patients; 34 were females and 31 were males, with an approximately equal male-to-female ratio. Patient age at surgery ranged from 35 to 86 years (average 63.44; SD: 12.25 years), and 30% of patients were older than 70 years old. There was a predominance of left lateralization of trigeminal neuralgia (40 out of 65, 61.5%) over right lateralization (25/65; 38%). The duration of symptoms before surgery ranged from 1 to 20 years (average: 6.23+/-4.23 years). There was involvement of the three trigeminal nerve branches in 8 patients, two branches in 35 patients, and a single branch in 22 patients.

During exploration of the CPA of these patients, the most frequent neurovascular conflict was type I (33 patients, 49.3%), then type IV (19 patients, 28.4%), then type II (10 patients, 14.9%), and the least frequent was type III (3 patients, 4.5%).

All patients showed significant resolution of their symptoms after surgery. There was no mortality in our series. No serious neurolog-

ic, cardiopulmonary, or circulatory problems were detected. Wound problems occurred in two patients: one subcutaneous cerebrospinal fluid collection and one subcutaneous hematoma; both were managed conservatively.

After at least 3 years of follow-up, 17 (26.1%) patients of the 65 had recurrence of their symptoms.

The average time for recurrence was 7.82+/-4.31 months; 95% of recurrences appeared within the first year—only one patient in the muscle group had recurrence, and it was 18 months after surgery.

We used multivariate statistical analysis to relate likelihood of postoperative recurrence of neuralgia to the following variables: patient's age and sex; involved side and branches; duration of symptoms; and type of neurovascular conflict (Table 1). No statistically significant prognostic clinico-demographic factor was identified; all p-values were  $>0.05$ .

The interposing material used during MVD was Teflon in 30 patients (group I), muscle in 19 patients (group II), and a combination of muscle and Teflon in 16 patients (group III). The three groups were homogenous for age, distribution of sex, side of involvement, duration of symptoms, number of involved branches, and the type of conflict, with all p values  $>0.05$  (Table 2).

Group I, Teflon interposition, showed the highest recurrence rate (40%); followed by group III, Teflon and muscle interposition (25%); Group II, muscle interposition, showed the lowest recurrence rate (5.2%) of the three groups. ANOVA found statistically significant differences for recurrence rate between the three groups ( $p \leq 0.005$ ). Group III did not differ significantly from group I (post hoc,  $p=0.0258$ ).

### DISCUSSION

Since MVD was popularized by Jannetta in the 1980s, it is considered by many as the only method that may provide a definitive cure

**Table 1.** Clinico-demographic data of patients with postoperative recurrent trigeminal neuralgia as compared to those without recurrence

	Recurrence	Non Recurrence	p value
Number	17 (26.1%)	48 (73.9%)	
Mean age (yrs)	56.41	65.94	0.06
Duration of symptoms (yrs)	5.47	6.50	0.394
Side (Right/Left)	7/10	18/30	0.793
Sex	M:7; F:10	M:24; F:24	0.539
Number of involved branches:			
One branch	5	17	0.884
Two branches	11	24	
Three branches	1	7	
Type of conflict:			
Type I	11	22	0.194
Type II	2	8	
Type III	1	2	
Type IV	3	16	

**Table 2.** Clinico-demographic data and postoperative outcome of patients who underwent microvascular decompression. Patients are stratified according to the interposed material used: Teflon, muscle, or a combination of both

	Group I (Teflon)	Group II (Muscle)	Group III (Muscle+Teflon)	p value
Number	30	19	16	
Mean age (yrs)	62.07	60.95	69	0.107
Duration of symptoms (yrs)	6.37	6.58	5.56	0.763
Side (Right/Left)	10/20	7/12	8/8	0.547
Sex (Female/Male)	14/16	10/9	10/6	0.604
Number of involved branches:				
One branch	10	7	5	0.930
Two branches	16	10	9	
Three branches	4	2	2	
Type of conflict:				
Type I	17	8	8	0.496
Type II	3	3	4	
Type III	2	0	13	
Type IV	8	8		
Recurrence	12/30 (40%)	1/19 (5.2%)	4/16 (25%)	0.025

in patients with trigeminal neuralgia (TN) [7, 12, 28-30]. Some of the criticisms about MVD are based on the presumed high mortality and morbidity. In our series, there was no mortality and no permanent morbidity. Broggi [31] reviewed more than 3000 published cases reported in the literature; he found that the mortality rate was 0.3% (12 of 3033).

The immediate success rate of MVD for the treatment of TN is as high as 96% [32, 33], but the incidence of significant recurrence of TN is reported to vary from 3±30% [5, 15, 16, 30, 32-37]. Tatli [7] reviewed 4884 patients who underwent MVD reported in the literature and found that the reported initial pain relief ranged from 76.4%-98.2%, and recurrence rates of the MVD group ranged from 4%-38%. In our series, we achieved a 100% rate of immediate success with a recurrence rate of 26% after a minimum 3 years of follow-up. We think that 3 years of follow-up is sufficient, since in the literature, almost all recurrences of TN after MVD occurred in the first 2 years after operation [5, 7, 19, 31, 38]. In our series, 95% of all recurrences occurred within 1 year of surgery, with a mean interval of 7.82±/-4.3.

Several causes for recurrence have been reported in the literature [17, 26, 28, 29]; Jannetta and Bissonate reported their experiences with 51 repeated MVD cases of TN, and they found vascular compression in the second operation in 42 cases (82%) [22].

After performing 132 second operations, Barker et al. [5] later reported either veins or small arteries to be the compressing vessels most frequently found in the second surgery.

Cho et al. [26] reported another large re-operative series; they found a negative exploration in 16 patients (52%), arterial loop compression in 7 (22%), venous compression in 4 (13%), and Teflon compression or adhesions in 4 (13%) to be the causes of recurrence.

In our series, we failed to relate likelihood of postoperative recurrence of TN to the following variables: patient's age and sex; involved side and branches; duration of symptoms; and type of neurovascular conflict. The only variable that was statistically correlated with recurrence rate was the type of interposing material. Using Teflon alone for isolation carries the highest rate of recurrence (40%), followed by using a combination of Teflon and muscle, which carries a recurrence rate of 25%. By using muscle as an interposing material, the recurrence rate was negligible (5%).

The endoscopically assisted retrosigmoid approach was initially developed by Bremond and Magnan [39-49]. Using endoscope-assisted surgery in vascular compression syndrome, the CPA is explored by a 30°-angled endoscope, which gives a panoramic view of this space and allows clear visualization of the whole trigeminal nerve region; this allows precise mapping of the site and the course of the offending vessel, minimizing missing any offending vessel and extensive retraction and dissection in the CPA. Finally, the quality of the surgical act and the absence of contact between the decompressed nerve and all adjacent vascular structures are controlled using the endoscope, which allows the performance of this control without disturbance to the microvascular decompression.

Using the sling technique, which maintains the offending artery far from the nerve without using any interposing material, may carry a lower risk of recurrence as compared to the interposition technique; however, this technique is not always feasible, especially when using a minimally invasive approach and could be dangerous, especially when dealing with the anteroinferior cerebellar artery (AICA), which generally has important perforators to the brainstem as well as the labyrinthine artery arising from its cisternal segment. This technique was feasible in only 10 patients out of the 97 operated patients.

Teflon felt has been thought to be an ideal material due to its tissue acceptance, the lack of resorption, little dislocation, and an overall low complication potential [50-52].

Nevertheless, Teflon is not such an inert material as presumed initially, and a neural tissue reaction to Teflon has recently been reported to be the cause of recurrent TN. Several reports of either Teflon felt fibrotic adhesion or Teflon-induced granuloma have increased in number [4, 26, 28, 29, 34, 52].

In three studies, histopathological examination of neural reaction to Teflon revealed microfragments of the Teflon felt surrounded by giant cells resembling a foreign body granuloma formation [26, 29, 53].

In contrast, a muscle autograft pad, which could be harvested from the surgical field, is self-tissue and normally does not induce foreign body reactions. This is reflected in the low rate of recurrence in the muscle group as compared to Teflon group. The only concern with the muscle pad is the problem of graft wasting under the offending vessel with time, which may lead to recurrence of symptoms, and this could be the underlying cause of the single patient in group II who experienced recurrence 18 months later after decompression. Wasting of muscle autografts is the concern of such interposing material, allowing compression again with the possibility of late recurrence. We did not see this problem in our series, either because we used a

relatively thick pad of muscle or because 3 years of follow-up is not sufficient for muscle wasting to take place.

According to our study, only the nature of the interposing pad has a significant impact on recurrence rate of TN. Muscle interposition seems to be very effective and has a very low recurrence rate (5%); however, Teflon pad use has a high rate of recurrence (40%). Although, there is still no standardized protocol for MVD, we suggest using a muscle graft for decompression of trigeminal neuralgia. Further work is needed to make the procedure even more effective.

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**Informed Consent:** Written informed consent was not obtained due to the retrospective nature of this study.

**Peer-review:** Externally peer-reviewed.

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