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THE LONG-TERM OUTCOME OF MICROVASCULAR DECOMPRESSION FOR TRIGEMINAL NEURALGIA

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Abstract *Background.* Several surgical procedures to treat trigeminal neuralgia (tic douloureux) are available, but most reports provide only short-term follow-up information.

Methods. We describe the long-term results of surgery in 1185 patients who underwent microvascular decompression of the trigeminal nerve for medically intractable trigeminal neuralgia. The outcome of the procedure was assessed prospectively with annual questionnaires.

Results. Of the 1185 patients who underwent microvascular decompression during the 20-year study period, 1155 were followed for 1 year or more after the operation. The median follow-up period was 6.2 years. Most postoperative recurrences of tic took place in the first two years after surgery. Thirty percent of the patients had recurrences of tic during the study period, and 11 percent underwent second operations for the recurrences.

Ten years after surgery, 70 percent of the patients (as determined by Kaplan–Meier analysis) had excellent final results — that is, they were free of pain without medication for tic. An additional 4 percent had occasional pain that did not require long-term medication. Ten years after the procedure, the annual rate of the recurrence of tic was less than 1 percent. Female sex, symptoms lasting more than eight years, venous compression of the trigeminal-root entry zone, and the lack of immediate postoperative cessation of tic were significant predictors of eventual recurrence. Having undergone a previous ablative procedure did not lessen a patient's likelihood of having a cessation of tic after microvascular decompression, but the rates of burning and aching facial pain, as reported on the last follow-up questionnaire, were higher if a trigeminal-ganglion lesion had been created with radiofrequency current before microvascular decompression.

Major complications included two deaths shortly after the operation (0.2 percent) and one brain-stem infarction (0.1 percent). Sixteen patients (1 percent) had ipsilateral hearing loss.

Conclusions. Microvascular decompression is a safe and effective treatment for trigeminal neuralgia, with a high rate of long-term success. (N Engl J Med 1996;334: 1077-83.)

TRIGEMINAL neuralgia, or tic douloureux, is a syndrome characterized by paroxysmal facial pain. Although many patients have adequate relief of symptoms when treated with carbamazepine or other drugs, some patients require surgical treatment because their symptoms are intractable or because they cannot tolerate the medications. Operative treatments in current use include neurectomy of trigeminal-nerve branches outside the skull; percutaneous ablation that creates trigeminal-nerve or trigeminal-ganglion lesions with heat (radiofrequency thermal rhizotomy[1]); injection of glycerol into the trigeminal cistern (retrogasserian glycerol rhizotomy[2]); or physical compression (trigeminal-ganglion balloon microcompression[3]). These procedures all cause controlled injury to the trigeminal nerve, ganglion, or root. Other procedures are intended to alleviate trigeminal neuralgia by relieving compression of the nerve at some point along its course.[4,5] In our study, we tracked 1185 patients with trigeminal neuralgia who underwent microvascular decompression of the trigeminal-nerve root over a 20-year period.

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METHODS

Patients

All patients who underwent microvascular decompression for trigeminal neuralgia (lancinating, shock-like pain within the trigeminal distribution) at the Presbyterian–University Hospital in Pittsburgh between January 1972 and December 1991 were eligible for enrollment in our study. Some patients, particularly those with long histories of tic, also had aching pain between paroxysms. However, if major pain usually lasted for a period of seconds to minutes, atypical trigeminal neuralgia was diagnosed; the 369 patients with such a diagnosis were excluded from the study, as were patients with tic due to multiple sclerosis or tumor (26 patients) and those with aneurysm (1) or arteriovenous malformation (5). After these exclusions, 1185 patients remained in the study group.

The operative technique has been described previously.[6] Through a small retromastoid craniectomy, the trigeminal nerve was examined microsurgically for vascular compression at or near its point of entry into the brain stem. Any compressive arteries, and some veins, were

repositioned with stents; other compressive veins were electrocoagulated and divided. Although most operations were performed by one surgeon, patients of other surgeons were also included in the study. Informed consent was obtained for all operations. Detailed reports on some subgroups of the study cohort (patients with bilateral tic[7] and patients with vertebrobasilar trigeminal compression[8]) and a statistical summary of 703 of the operations after 6.5 years of follow-up have appeared previously[6,9,10]; the results of both those procedures and the remaining 501 operations in the study group are described here.

Data Collection and Outcome Criteria

The presence of individual symptoms of tic, operative findings, and complications were recorded. The immediate postoperative relief of symptoms was graded as complete, partial, or poor during the first week after surgery. Operative results were at first assessed by clinical follow-up and periodic telephone surveys. Beginning in 1980, annual questionnaires were sent to all patients asking them about the presence and nature of any facial pain and the details of any subsequent treatment for tic. The patients were asked to grade the severity of their residual pain in comparison with preoperative symptoms. Patients who did not return questionnaires were traced through relatives and referring physicians; those who did not return questionnaires for two consecutive years and who could not be traced were considered lost to follow-up, and their cases were included in the analysis only up to their last actual contact. Follow-up ended in January 1993.

The outcome of the intervention was graded by personnel other than the operating surgeon. Complete relief of symptoms, or excellent outcome, was defined as the absence of lancinating facial pain, or a reduction in pain of at least 98 percent (as compared with the level of pain present preoperatively), as assessed by the patient, without medication for tic. Some patients took medication for contralateral tic; if the operated side was pain-free, such patients were still considered to have an excellent outcome. Partial relief, or good outcome, was defined as a 75 percent reduction in pain as assessed by the patient; intermittent treatment with low doses of medication was allowed in this category. If symptoms were judged to be present at more than 25 percent of the preoperative level, long-term medication was resumed, or an additional surgical procedure for tic was performed, the outcome of the initial surgery was classified as poor or a failure. The presence of constant, aching, or burning facial pain that was not lancinating or paroxysmal was not considered a criterion for failure. Follow-up for this study was terminated after any additional operation except a second microvascular decompression or after two consecutive annual reports of failure. Failures that occurred before the first post-discharge evaluation were considered to have taken place one month after the operation. Since the first follow-up assessment for some patients was more than one year after surgery, some failures assigned to the first postoperative year may actually have occurred in the second postoperative year.

Patients followed for less than one year (49 [4 percent]) were excluded from the outcomes analysis but included in other analyses. The proportion of patients with immediate postoperative relief from tic in this group did not differ from that among patients with longer follow-up ($P=0.55$). Patients who underwent bilateral microvascular decompression were counted twice (once for each side of the face) for purposes of the analysis of outcomes.

Statistical Analysis

The results of Fisher's exact test are reported for two-by-two tables; the Mann–Whitney test was used to assess the significance of ordinal variables, and the unpaired t-test or analysis of variance was used for continuous variables. Kaplan–Meier curves were calculated with the Turnbull modification for interval-censored survival data.[11] We calculated the postoperative rate of recurrence of tic using life-table analysis, with confidence intervals from Gehan's variance estimate.[12,13] For the life-table and proportional-hazards analyses,[13] the exact time of failure was defined as the midpoint between the dates of the last report of a successful outcome and the first report of failure. All statistical tests were two-tailed.

Results

Between 1972 and 1991, 1166 patients underwent unilateral microvascular decompression and 19 underwent bilateral microvascular decompression, for a total of 1204 initial decompressions in 1185 patients. The baseline characteristics of the patients are shown in Table 1.

Table 1. Base-Line Characteristics of the 1185 Study Patients.

Characteristic	Value
Age at surgery — yr	
Median	57
Range	5–87
Male sex — no. (%)	479 (40)
Site of operation — no. (%)	
Left side of face	442 (37)
Right side of face	724 (61)
Bilateral*	19 (2)
Age at onset of symptoms — yr	
Median	49
Range	2–82
Preoperative duration of symptoms — yr	
Median	6
Range	<1–44
Prior drug treatment — no. (%)†	
Carbamazepine	1115 (94)
Phenytoin	627 (53)
Baclofen	170 (14)
Prior ablative treatment — no. (%)	
Any procedure	326 (28)
Peripheral-nerve procedures	203 (17)
Radiofrequency gasserian lesions	96 (8)
Glycerol rhizotomy	51 (4)
Other‡	36 (3)
Distribution of pain — no. (%)§	
V_1 only	33 (3)
V_2 only	213 (18)
V_3 only	176 (15)
V_1 and V_2	207 (17)
V_2 and V_3	427 (36)
V_1, V_2, and V_3	148 (12)
Preoperative facial numbness — no. (%)	
Hypesthesia	438 (37)
Hypalgesia	435 (37)
Decreased corneal reflex	103 (9)

*Patients who underwent bilateral operation are counted twice in some tabulations. Seventy-six patients (6 percent) had bilateral tic.

†Forty-seven percent of patients used two medications, and 7 percent used all three.

‡Other ablative procedures included Spiller–Frazier subtemporal trigeminal rhizotomy, posterior-fossa trigeminal rhizotomy, and percutaneous trigeminal-ganglion injections of alcohol, phenol, or hot water. Some patients had undergone more than one type of ablative procedure.

§V_1, V_2, and V_3 denote the ophthalmic, maxillary, and mandibular divisions of the trigeminal nerve, respectively.

The follow-up rate at 5 years was 91 percent, and at 10 years it was 87 percent. The questionnaire response rate, for two typical years, was 97 percent in 1991 and 94 percent in 1992. The median length of follow-up for the 1155 patients followed for 1 year or more was 6.2 years.

In the study group, 121 patients (10 percent) were lost to follow-up for reasons other than death. These patients had the same distribution of outcomes, as assessed immediately before their loss to follow-up, as the remainder of the group ($P=0.14$). Loss to follow-up was significantly more frequent among younger patients ($P<0.001$) and patients who lost ipsilateral hearing as an operative complication ($P=0.005$). Immediate postoperative relief from tic, postoperative facial weakness, and postoperative numbness did not significantly predict loss to follow-up.

By Kaplan–Meier analysis, postoperative survival

Table 2. Vessels Identified at Operation as Compressing the Trigeminal Nerve.

Vessel	First Operation (N = 1204)	Reoperation (N = 132)
	number (percent)	
Superior cerebellar artery	909 (75)	27 (20)
Anterior inferior cerebellar artery	116 (10)	4 (3)
Posterior inferior cerebellar artery	8 (1)	0
Vertebral artery	19 (2)	0
Basilar artery	9 (1)	0
Labyrinthine artery	3 (<1)	1 (1)
Unspecified small artery	186 (15)	47 (36)
Vein	822 (68)	95 (72)
Vein only	151 (13)	49 (37)
Vein and artery	671 (56)	46 (35)
Unspecified small artery or vein only	223 (19)	102 (77)

was 93 percent after 10 years and 70 percent after 20 years. At the time of operation, the patients' median life expectancy, calculated from age- and sex-specific tables for the 1987 U.S. population,[14] was 23 years.

Preoperative Symptoms and Previous Treatment

Preoperative symptoms for the study group are summarized in Table 1. The mean duration of preoperative symptoms did not change during the 20 years of the study period. The patients with longer preoperative histories of tic had pain in more trigeminal divisions; the mean duration of pain was 6.8, 7.2, and 8.7 years for patients with pain in one, two, and three divisions, respectively ($P=0.004$). Among the 326 patients who had undergone previous trigeminal ablative procedures, the mean duration of symptoms before microvascular decompression was longer than among the patients who had not had such procedures (9.4 vs. 6.4 years, $P<0.001$).

Operative Findings and Complications

The operative findings are summarized in Table 2. The trigeminal root was compressed by the superior cerebellar artery in 75 percent of patients. A vein contributed to the compression in 68 percent of patients and was the only compressing vessel in 12 percent. A small unspecified artery or vein was more frequently the only compressing vessel in women than in men (21 percent vs. 15 percent, $P=0.004$).

Operative complications are shown in Table 3. Two patients died, a 79-year-old woman who had a cerebral hemispheric stroke after surgery and a 69-year-old woman who had an infarction of the brain stem and cerebellum after surgery, apparently due to occlusion of the superior cerebellar artery. Six patients had infarction, edema, or hemorrhage of the ipsilateral cerebellar hemisphere, of whom five were treated by cerebellar resection. Two patients had postoperative supratentorial hematomas (one subdural and one intracerebral) that required evacuation. These eight patients recovered without permanent sequelae.

Severe facial numbness occurred after the initial microvascular decompression in 11 patients. There were no cases of postoperative anesthesia dolorosa (facial anesthesia with severe paresthesia). Burning and aching facial pain was reported by 3 percent and 4 percent of the patients, respectively, after a single microvascular decompression and no prior ablative procedures. Of the 878 patients who had not undergone prior ipsilateral ablative surgery, 3 reported receiving postoperative treatment with a tricyclic antidepressant drug or related medication for burning or aching pain. Of the 326 patients in whom a prior ipsilateral ablative procedure had been performed, 4 reported postoperative treatment with tricyclic antidepressants or related drugs for burning or aching pain that was not clearly attributable to the ablative procedure. Burning or aching facial pain was more commonly reported by the 96 patients with radiofrequency lesions of the trigeminal ganglion than by other patients ($P<0.001$ for burning pain and $P=0.002$ for aching pain), but not by any other subgroup defined according to the type of ablative procedure.

Fifteen patients had ipsilateral hearing loss, which was severe in 14. One additional patient had moderate contralateral hearing loss. Hearing loss was not significantly correlated with the patient's age or sex, the decompression of the facial as well as the trigeminal nerve, or the repositioning of any specific artery. No patient had permanent facial weakness after a first microvascular decompression. Two patients had postoperative diplopia that lasted longer than one year and is

Table 3. Complications of 1336 Microvascular Decompression Operations for Typical Trigeminal Neuralgia.

Complication*	First Operation (N = 1204)	Reoperation (N = 132)	Total (N = 1336)
Death	2	0	2
Brain-stem infarct	0	1	1
Cerebellar hematoma	2	0	2
Supratentorial hematoma	2	0	2
Cerebellar edema	4	0	4
Hydrocephalus	2	0	2
Facial paresis			
Transient	6	4	10
Permanent, mild	0	1	1
Permanent, severe	0	1	1
Ipsilateral hearing loss			
Permanent, mild	1	0	1
Permanent, severe	14	1	15
Extraocular muscle palsy			
Trochlear, transient	11	0	11
Trochlear, permanent	2	0	2
Abducens, transient	2	0	2
Severe facial numbness	11	11	22
Cerebrospinal fluid leak	17	3	20
Pseudomeningocele	4	0	4
Bacterial meningitis	4	1	5
Chemical meningitis†	198	27	225

*The following other complications also occurred: pneumonia (n = 2), septicemia (n = 1), subendocardial myocardial infarction (n = 1), transverse-sinus thrombosis (n = 1), pulmonary embolus (n = 1), and moderate, permanent contralateral hearing loss (n = 1).

†Chemical meningitis denotes self-limited symptoms of meningismus not deemed due to infectious causes.

No. of Patients										
Good or excellent outcome	554	303	136	5	600	340	152	5	39	23
Excellent outcome	516	288	129	4	561	324	144	4	34	21

Figure 1. Kaplan–Meier Analysis of the Success of Microvascular Decompression for Trigeminal Neuralgia.

The curves show the proportions of patients with successful outcomes (defined in the text) after the first microvascular decompression only, for all 1185 patients (1204 procedures, Panel A); after one or two microvascular decompression procedures, for all 1185 patients (1336 procedures, Panel B); and after the second operation only, for 132 patients (132 procedures, Panel C). Forty-nine patients with less than a year of follow-up were excluded.

assumed to be permanent. Wound complications were all managed without lasting sequelae. Two patients required cerebrospinal fluid shunts for postoperative hydrocephalus.

Complications were less frequent after intraoperative monitoring of brain-stem evoked response began in 1980. Since 1980, 773 consecutive first microvascular decompressions for tic have been performed with no deaths. The rate of ipsilateral hearing loss was 3 percent before 1980 and 1 percent thereafter ($P = 0.008$).

Outcome after Microvascular Decompression

Immediate postoperative relief from tic was complete in 82 percent of patients, partial in 16 percent, and absent in 2 percent. One year after microvascular decompression, 75 percent of the patients had complete relief after the first operation (excellent outcome), and 9 percent had partial relief (good outcome). Ten years after the procedure, 64 percent had excellent results and 4 percent had partial relief (Fig. 1A).

The rate of recurrence of tic after a first microvascular decompression was estimated by life-table analysis (Fig. 2). The annual risk of recurrence (i.e., of transition from the group with excellent outcome to either the good-outcome or the poor-outcome group) was less than 2 percent 5 years after the operation and less than 1 percent after 10 years. The annual rate of recurrence during the second postoperative decade was 0.7 percent (9 recurrences in 1251 patient-years). A total of 132 patients (11 percent) had second operations for recurrent or refractory tic.

With the inclusion of the final outcome of surgery for patients who had either one or two operations, one year after microvascular decompression 80 percent of the patients had excellent results and 8 percent partial relief; 10 years after operation, 70 percent had excellent results and 4 percent had partial relief (Fig. 1B).

Of 282 patients with final outcomes of failure, 34 percent resumed taking medication, 20 percent underwent ablative trigeminal procedures, 22 percent did both, and 24 percent reported no further treatment for tic.

Prognostic Factors for Success

Proportional-hazards analysis was used to relate the likelihood of the postoperative recurrence of tic to the following variables: the patient's age and sex; the side of the face where symptoms occurred; the duration of symptoms; the number of trigeminal divisions involved; any history of trigeminal ablative procedures; the presence of trigger points; preoperative hypesthesia or hypalgesia; contralateral tic; ipsilateral hemifacial spasm or glossopharyngeal neuralgia; the anatomical findings at operation; the performance of a partial trigeminal rhizotomy (21 patients [2 percent]); and the degree of immediate postoperative relief from symptoms. Four analytic models were constructed. In one model, excellent outcome after one microvascular decompression was considered success; in a second, either good or excellent outcome was deemed success. In the other two models, the same criteria for success were used, but the final outcome after either one or two operations was considered. Four analytic step-up models were constructed. The variables were considered significant if they could be entered into at least two of the four models at the $P<0.05$ level.

Four factors predicting long-term relief from tic after microvascular decompression were identified: immediate postoperative relief; male sex; absence of venous compression of the trigeminal-root entry zone; and a duration of preoperative symptoms of less than eight

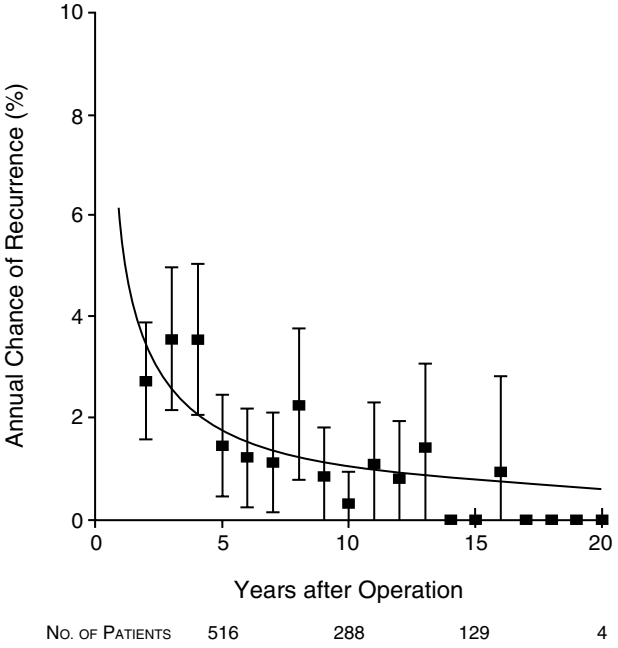

Figure 2. Recurrence of Trigeminal Neuralgia in Patients with Postoperative Relief after Microvascular Decompression.

Recurrence is defined as meeting the criteria for good or poor results after initially excellent results. Forty-nine patients with less than a year of follow-up were excluded. For each postoperative year (starting with year 2), the life-table rate of recurrence is shown. The bars denote 95 percent confidence intervals. A power-function curve has been fitted to the data. The rate of recurrence falls below 2 percent at year 5, and below 1 percent at year 10. The numbers of patients with excellent results remaining in the analysis are shown below the figure.

years. Since hazard ratios for these variables were very similar in the four models, hazard ratios are given only for the model defining success as excellent outcome after one operation (Table 4). Bilateral tic, ipsilateral hemifacial spasm, or history of an ablative procedure before microvascular decompression did not significantly increase the likelihood of the recurrence of tic in any model.

Second Operations

Of the 132 second operations required in the study group, 10 percent were performed within 30 days after the initial surgery and 58 percent within 2 years. Veins or small arteries were the compressing vessels most frequently found in patients undergoing second operations (Table 2).

Complications are listed in Table 3. There were no deaths. One patient had transient dysarthria and ataxia in the right arm, which was attributed to a brain-stem infarction, although no brain-stem abnormality was seen with magnetic resonance imaging. Cranial-nerve complications were more frequent after second operations: 2 patients had persistent facial weakness, and 11 had severe facial numbness.

As a group, second operations were less successful than first microvascular decompressions (Fig. 1). Ten years after repeated surgery, 42 percent of patients had excellent results and another 5 percent had good results. Most failures occurred within two years after the second operation. In a proportional-hazards model, immediate postoperative relief from tic after repeated surgery predicted excellent long-term outcome ($P = 0.003$), as it did for first decompressions.

Patients' Assessments of Outcome

Of the 875 patients whose most recently returned questionnaires were available for review, 99.7 percent of those whose outcomes were classified as excellent and 93 percent of those whose outcomes were classified as good considered their surgery to have been successful. Forty-eight percent of the patients whose outcomes were classified as failure also considered the surgery to have been successful.

Discussion

Trigeminal neuralgia usually begins as a relapsing disease with pain-free intervals that may last months or years. These intervals, however, typically grow shorter and eventually disappear. As the disease progresses, patients can have difficulty talking, eating, and maintaining facial hygiene out of fear of triggering the pain. Current treatment usually begins with carbamazepine, which frequently provides relief from symptoms. Unfortunately, the relief provided by carbamazepine or other drugs may decrease over time, and side effects such as hyponatremia or difficulty with balance may necessitate discontinuation of the medication.[15] About half of all patients eventually require an operation for pain relief.[16]

We found microvascular decompression to be a safe and effective treatment for patients with medically intractable typical trigeminal neuralgia. Although direct comparisons between series are hindered by differing definitions of operative success, our results are similar to those of other studies of the recurrence of tic after microvascular decompression that used actuarial methods.[17-22] In our study, the annual rate of recurrence of tic fell below 2 percent 5 years after surgery and below 1 percent by 10 years. The large size and extended follow-up in our cohort (288 patients were free of pain 10 years after surgery) permit a more precise estimate of

Table 4. Hazard Ratios for Factors Predicting the Recurrence of Tic after 1204 First Microvascular Decompression Operations.*

Risk Factor	Hazard Ratio (95% CI)	P Value
Lack of immediate postoperative relief	2.8 (2.4–3.4)	<0.001
Female sex	1.3 (1.1–1.7)	0.006
Venous compression of trigeminal-root entry zone	1.2 (1.0–1.5)	0.10
Preoperative symptoms lasting >8 yr	1.3 (1.0–1.5)	0.03

*Each hazard ratio compares the rate of recurrence among patients with the risk factor with that among patients without it. CI denotes confidence interval.

the annual recurrence rate after microvascular decompression than those (2 percent[17] to 4 percent[18]) that were previously available.

Several percutaneous operative treatments for trigeminal neuralgia are in current use: radiofrequency to create lesions of the trigeminal ganglion,[1] glycerol rhizotomy,[2] and balloon compression of the trigeminal ganglion.[3] Percutaneous procedures are less invasive than microvascular decompression and are associated with low rates of mortality and morbidity.[23] However, these procedures all create trigeminal-nerve lesions, occasionally producing anesthesia dolorosa or keratitis.

Trigeminal neuralgia is no longer a disease limited to the last few years of life. The median life expectancy in our patients was 23 years at the time of operation, or 29 years from the time tic symptoms began. The long-term actuarial rates of success of other operative treatments have generally been lower than the success rate among our patients. Although a 75 percent success rate 14 years after the creation of gasserian lesions by radiofrequency has been reported,[24] other studies found that only approximately 20 percent of patients remained free of pain 6 to 7 years after this procedure.[21,25] Fujimaki et al.[26] reported that 28 percent of patients were free of pain 54 months after glycerol rhizotomy; Burchiel[27] reported similar results.

Low rates of severe postoperative facial numbness (1 percent) and dysesthesia (0.3 percent requiring treatment) in our study are additional advantages of microvascular decompression. Facial numbness is correlated with relief from tic after both radiofrequency thermal rhizotomy[24,28] and glycerol rhizotomy.[27,29,30] Although larger gasserian lesions created by thermal rhizotomy are more effective in preventing the recurrence of tic, severe facial numbness and dysesthesia are also more likely. Seventy-five percent of 179 patients reported facial numbness after radiofrequency thermal rhizotomies in one series, as compared with only 22 percent after microvascular decompression.[21] Facial pain of types traditionally associated with nerve injury was also more common after radiofrequency rhizotomy than after microvascular decompression in that study (37 percent vs. 13 percent).[21] In our study, an unsuccessful radiofrequency-lesion procedure before microvascular decompression was a significant risk factor for postoperative burning and aching facial pain.

Four factors predicted higher rates of recurrence of tic after microvascular decompression: female sex, preoperative symptoms lasting longer than eight years, decompression of a vein in the operation, and a lack of immediate postoperative relief. Female sex[17,31,32] and a longer preoperative history of tic[17,31,33-35] have been reported as risk factors for recurrence after microvascular decompression. Operative findings at microvascular decompression have also been correlated with outcome.[18,20,22,32,33,36,37] In some analyses, patients with more severe vascular compression of the trigeminal root had more successful relief of symptoms after microvascular decompression.[20,22,32,33] We did not record the severity of compression at the time of operation, and we think that a retrospective review of operative records would not be an adequate substitute for such assessment. This analysis showed that venous compression of the trigeminal root predicted a higher rate of recurrence, as has been noted previously, for both tic[36-38] and hemifacial spasm.[39]

Many patients awaken without pain after a successful microvascular decompression and remain pain-free. In others, tic resolves gradually during the week or two after operation. Incomplete pain relief during the first postoperative week predicted long-term recurrence of tic in our patients. The number of trigeminal divisions affected by tic was not a prognostic factor in our series or in other reports.[17] A preoperative sensory deficit or a history of a trigeminal ablative procedure, both previously reported as unfavorable prognostic factors,[18,32,34,35] were not significant in our analysis.

In summary, we found microvascular decompression to be safe and effective in relieving typical trigeminal neuralgia. The high rate of long-term success makes it an attractive treatment for eligible patients with medically intractable tic.

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