Trigeminal Neuralgia: What are the Important Factors for Good Operative Outcomes with Microvascular Decompression

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BACKGROUND
Microvascular decompression has been widely used as the first choice in treating trigeminal neuralgia, but in a few patients, facial pain cannot be effectively controlled by microvascular decompression. We sought to clarify the important factors for good operative outcomes.

METHODS
We reviewed 62 patients with trigeminal neuralgia treated by microvascular decompression during the period 2000 through 2002, including clinical presentation, operative findings, techniques, and outcomes. Neurovascular conflicts were divided into single contact, contact and indentation, single adhesion, adhesion and indentation, and trigeminal nerve atrophy. Operative outcomes were graded into immediate postoperative complete pain relief (excellent), delayed postoperative complete pain relief (better), significant pain relief (good), and no response to microvascular decompression (poor).

RESULTS
All patients’ presentations were typical at the time of pain onset, but the symptom in 17 patients changed to atypical before surgery. During operation, single contact and single adhesion was found in 14 patients and 15 patients, respectively; contact or adhesion in combination with indentation was found in 7 patients and 18 patients, respectively; atrophy occurred in 8 patients. Postoperatively, immediate and delayed complete pain relief was achieved in 32 (51.6%) patients and 17 (27.4%) patients, respectively; 11(17.7%) patients got significant pain relief; and 2 patients showed no response. The overall rate of complete pain relief in patients with shorter duration, typical presentation, artery compression and complete decompression was higher than that in patients with longer duration, atypical presentation, venous compression, and incomplete decompression.

CONCLUSIONS
Shorter duration, typical presentation, single artery compression, and complete decompression are the positive factors for better operative outcomes with microvascular decompression. Worse outcomes are usually related to venous compression, longer duration, and atypical presentation. © 2004 Elsevier Inc. All rights reserved.

KEY WORDS
Trigeminal neuralgia, microvascular decompression, operative outcomes, prognostic factors.

Since Dandy [5] first described the compression of blood vessels on the root of trigeminal nerve as the reason for trigeminal neuralgia (TN), the theory of neuro-vascular conflicts (NVC) was widely accepted, and microvascular decompression (MVD) was gradually used in treating TN [7–9]. Since Jannetta et al [11,12] developed and popularized microvascular decompression in the 1970s, microvascular decompression is used as the first choice in treating patients with TN, but the surgical outcomes are variable in different reports. In fact, not all of the patients with TN could be cured by MVD; sometimes the facial pain could only be alleviated, and a few patients showed no response to MVD [2,3,6,13,16]. To improve the operative outcomes with MVD, some authors tried to refine the operative techniques and paid great attention to patient selection for MVD [1,15,19,21]. Fewer papers on the predictors of operative outcomes with MVD have been reported until now. To clarify the influential factors of operative outcomes with MVD, we reviewed and analyzed the data of 62 patients with TN treated by microvascular decompression in our neurologic department, including age, initial symptoms, durations, clinical presentations, NVC, and operative outcomes.
Patients and Methods
Between 2000 and 2002, 62 patients with TN were admitted and treated first by microvascular decompression at the Department of Neurosurgery, Tongji Hospital of Tongji University. On admission, each patient’s history and clinical condition were checked and recorded in detail, including sex, age, initial symptoms, durations, trigger points, pain distribution and characteristics, and past treatment. Of these patients, their clinical presentations were divided into typical and atypical TN. Typical TN was defined by 4 features: 1) lancinating and electrical pain in one or more trigeminal nerve distributions; 2) having definite trigger points; 3) having definite trigger stimuli or activities; 4) memorable onset of TN. Atypical TN denoted the following: 1) without definite trigger point; 2) having intermittent facial pain or persistent pain; 3) suffering from facial numbness or dysesthesia.

Clinical Presentation
Of 62 patients, 19 were male and 43 were female; 46 patients had pain on the right side, and 16 patients had pain on the left side. The age at the time of pain onset ranged from 30 to 83 years, with a mean age of 60 years. Their durations ranged from 1 month to 15 years, with a mean duration of 4.4 years. The age at the time of surgery ranged from 35 to 84 years, with a mean age of 63.6 years. All of these patients had a typical presentation at the time of onset, while 17 patients presented atypical before surgery for MVD. There was no definite trigger pain attack in all of the 17 atypical patients, 11 of which had facial numbness, and 12 had intermittent facial pain. Single V1, V2, or V3 distribution was involved in 1, 11, and 7 patients, respectively. Combination of V2 and V3 distribution was the most commonly involved pattern, which occurred in 29 (46.8%) patients, and 8 (12.9%) patients suffered pain in V1 and V2 distribution. In the other 6 (9.7%) patients, pain involved the whole ipsilateral face.

Operative Techniques
A cerebellar superior-lateral approach was used for MVD in all 62 patients and practiced by the same neurosurgeon group. During operation, we ascertained the anatomic relationships between trigeminal nerve and surrounding structures from the region of root entry zone (REZ) medially to Meckel’s cave laterally, and recorded in detail the anatomic changes of trigeminal nerves, the category, size, and number of offending vessels and the sites and severity degree of neurovascular conflicts. The vessels compressing degree was classified into 5 categories: single contact, contact and indentation, single adhesion, adhesion and indentation, and trigeminal nerve atrophy.

For microvascular decompression, Teflon sponge was used in all patients. Before the end of surgery, we checked and recorded the final decompressing degree as complete or incomplete. Complete decompression denotes that all offending vessels were dissected and moved away from trigeminal nerve, anatomic replacement of the trigeminal nerve, and Teflon was inserted enough to keep the vessel off the nerve. Incomplete decompression resulted from 4 different reasons in this study: 1) the offending vessel was a large vein, and the adhesion could not be dissected from trigeminal nerve; 2) offending artery passed through trigeminal neurofibers; 3) offending vessel was located in the region of REZ and gave off several penetrating arteries into the brain stem. Teflon sponge could not be inserted sufficiently into the limited inter-space; 4) the root of the trigeminal nerve was compressed and elongated for a long time, and after moving away the offending vessel, the trigeminal root could not be replaced anatomically as usual.

Results
Operative Findings
Of 62 patients, artery compression was found in 47 patients, artery compression in combination with venous compression occurred in 13 patients, and the offending vessels could not be named in 2 patients (Table 1).

The neurovascular conflicts were as follows. Single contact between offending vessel and trigeminal nerve was found in 14 (22.6%) patients. Contact and
indentation occurred in 7 (11.3%) patients. Single adhesion was encountered in 15 (24.2%) patients, while adhesion and indentation occurred in 18 (29%) patients, and trigeminal nerve atrophy was found in 8 (12.9%) patients. At the end of operation, complete decompression was achieved in 50 (80.6%) patients, while incomplete decompression was achieved in 12 (19.4%) patients, which resulted from several reasons such as venous compression in 6 patients, medial heavy adhesion in 1 patient, vessel passing through trigeminal nerve in 7 patients and penetrating arteries into brain stem in 4 patients.

**OPERATIVE OUTCOMES**

The operative outcomes were graded into 3 categories: 1) excellent: immediate or delayed postoperative complete pain relief without the need for medications; 2) good: significant pain relief, which is defined as a 75% or greater reduction of preoperative pain with or without the use of medications; 3) poor: no response to MVD or only little pain relief, which is defined as a less than 75% reduction in the amount of preoperative pain.

In postoperative hospital days, we recorded the pain condition every day, and all of the patients were followed for a period of 10 to 27 months as outpatients, with an average 13 months. Thirty-two of 62 patients (51.6%) awoke pain-free (excellent response) after MVD, 28 patients (45.2%) showed significant (>75%) but incomplete pain relief (partial response) with MVD, and 2 patients (3.2%) demonstrated no response to MVD. During the follow-up days, 17 (27.4%) patients gained delayed but complete pain relief, so at the time of their last follow-up, 49 patients (79%) were pain-free without medications, and 11 patients (17.7%) remained with only partial response.

Of 18 patients with duration no longer than one year in this study, immediate postoperative complete pain relief was achieved in each patient (100%), but among 13 patients with duration longer than 8 years postoperatively, immediate and delayed complete pain relief were achieved in only 2 patients and 4 patients, respectively. The overall rate of complete pain relief was 46.2% \( (p < 0.01, \text{compared with } 100\%) \), with significant partial pain relief and no response to MVD occurring in 5 and 2 patients, respectively.

As shown in **Table 2**, in 45 patients with typical presentation before MVD, postoperatively immediate and delayed complete pain relief was achieved in 32 patients and 12 patients respectively, so the overall rate of complete pain relief was 97.8%; yet in 17 patients with atypical presentation, the overall rate of postoperative complete pain relief was only 29.4% \( (p < 0.01, \text{compared with } 97.8\%) \).

Among 13 patients with a combination of vein and artery compression, the overall rate of complete pain relief was achieved in 6 (46.2%) patients, 5 (38.5%) patients got significant pain relief, and 2 patients demonstrated no response to MVD. On the contrary, among 49 patients with only artery compression, postoperatively immediate and delayed complete pain relief was achieved in 29 (59.2%) and 14 (28.6%) patients, respectively, and 6 patients showed significant pain relief. The overall rate of complete pain relief was 87.8% \( (p < 0.05, \text{compared with } 46.2\%) \).

As shown in **Table 3**, immediate postoperative complete pain relief was achieved in all (100%) of the 14 patients with single contact between the offending vessel and trigeminal nerve, but in 15 patients with single adhesion and 18 patients with combination of adhesion and indentation, postoperatively immediate complete pain relief was achieved in only 9 (60%) \( (p < 0.05, \text{compared with } 100\%) \) and 3 (16.7%) patients \( (p < 0.01, \text{compared with } 100\%) \), respectively.

Complete decompression was achieved in 50 (80.6%) patients. The overall rate of complete pain relief was 94%. Whereas among 12 (19.4%) patients with only incomplete decompression during operation, the overall rates of complete pain relief was only 16.7% \( (p < 0.01, \text{compared with } 94\%) \).
As shown in the present study, microvascular decompression is a safe and effective method in treating TN, even if the facial pain is very severe and intractable with medications or other treatments before microvascular decompression. Unfortunately, we do not have good records regarding the methods and outcomes of these patients’ past treatments such as medications, percutaneous ablation, trigeminal nerve neurectomy, radiation therapy, etc., but the past treatments seemed to have no clear correlation with the final operative outcomes with microvascular decompression.

As mentioned in previous reports [4,10,17], the overall operative outcome with MVD in younger patients with TN is not the same as that in adults with TN. In our present report, we didn’t find the patients’ ages at the time of surgery related to the operative outcomes of MVD, and we believe microvascular decompression is still the first choice and an effective treatment for older patients with TN.

As shown in this study, the operative outcomes of microvascular decompression in treating patients with TN is defined by several factors. There is a clear trend that patients with TN of shorter symptom duration and typical presentation always predict better operative outcome with MVD. It is an interesting finding of this study, that with prolonged duration, the symptoms in 17 of 62 patients changed from initial typical presentation to atypical presentation before surgery, which might be responsible for the poorer operative outcomes. So, it is a wise decision to perform MVD for patients with TN at the typical presentation stage.

In addition, the offending vessels and the degree of NVC and final decompression are also important prognostic factors for MVD. It is reasonable to believe that the operative performance will be easier and the surgical outcomes will be better if the root of the trigeminal nerve is compressed mainly by artery, the NVC is not severe, and the decompression is complete.

In other words, in addition to patient selection and operative techniques, the operative outcomes with microvascular decompression in treating TN were influenced by several factors such as duration, clinical presentation, offending vessels’ category and compression and decompression degrees. From the experience of this study, MVD should be considered as the best treatment choice for TN patients with the following clinical features: 1) shorter duration, especially if it is no longer than 3 years; 2) symptom is typical, especially with very severe trigger pain; 3) the distribution and clinical feature of facial pain is unchanged since the time of pain onset. In addition to patient selection, the following operative techniques are thought to be helpful to improve operative outcomes: 1) careful exploration should be considered along the root of trigeminal nerve to avoid any offending vessel, especially in the region medial to the trigeminal root and the lateral portion of trigeminal root near Meckel’s cave [18]; 2) thorough dissection of the adhesion, keeping the offending vessel away from trigeminal root, sometimes cutting some trigeminal neurofibers; 3) when the offending vessel gives off penetrating artery into brain stem, which is a barrier for complete decompression, it is encouraged to carefully dissect the offending vessel and penetrating artery from the trigeminal nerve and place some Teflon sponge between them [15]; 4) for venous compression, the little vein can be directly coagulated and cut off, but for the large vein we usually use sharp dissection techniques to move the offending vessel away from the trigeminal nerve, the finally inserting enough Teflon sponge to keep the vein off the trigeminal nerve [14]; 5) try to anatomicly replace the trigeminal nerve, with the ideal position of Teflon sponge between the compressing vessel and brain stem, sometimes moving

### Correlation Between Operative Outcomes and Vessel Compressing and Decompressing Degree

<table>
<thead>
<tr>
<th>OPERATIVE OUTCOMES</th>
<th>NO. OF PATIENTS</th>
<th>VESSEL’S COMpressing DEGREE</th>
<th>DECOMpressING DEGREE</th>
</tr>
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<tbody>
<tr>
<td>Excellent</td>
<td>IPCPR 32</td>
<td>14 6 9 3 0</td>
<td>32 0</td>
</tr>
<tr>
<td></td>
<td>DPCPR 17</td>
<td>0 1 5 8 3</td>
<td>15 2</td>
</tr>
<tr>
<td>Good</td>
<td>11</td>
<td>0 0 1 6 4</td>
<td>3 8</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>0 0 0 1 1</td>
<td>0 2</td>
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IPCPR, immediate postoperative complete pain relief; DPCPR, delayed postoperative complete pain relief; C, contact; C&I, contact and indentation; A, adhesion; A&I, adhesion and indentation; AT, atrophy.
away the compressing vessel from the trigeminal nerve and keeping it in position with fibrin glue [20].

REFERENCES

COMMENTARIES
The authors have to be acknowledged for their good results and for reviewing their 62 patient series for prognostic factors to better understand failure cases.

The authors’ overall results (79% of patients pain-free, with a follow-up ranging from 10–27 months, 13 months on average) are well in the range of published series.

In our own series of 579 patients, assessed after a follow-up ranging from 3 to 20 years (9 years on average), 76.1% of patients were pain free: four-fifths immediately, one-fifth after a (few months) delay.

Considering prognostic factors, Li et al conclude that shorter duration of pain before surgery, typical presentation, single artery compression, single contact, are positive factors for better operative outcomes. Study of prognostic factors in our series led us to different conclusions. We did not find pejorative influence of pain duration before surgery, atypical presentation of neuralgia, multiplicity of compressive vessels. Further, the stronger the neurovascular conflict, the better the long-term result. Concerning the surgical technique, we had better outcome when the prosthesis used to maintain the offending vessel apart was not touching the trigeminal root, i.e., when MVD achieved a real decompression (rather than a neo-compression).

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This retrospective clinical review of 62 patients with trigeminal neuralgia treated with microvascular decompression (as an initial surgical procedure) echoes much of what has been already published in several previous papers. In their review of 62 patients with trigeminal neuralgia who were operated by microvascular decompression, the authors achieved 79% complete success rate of eliminating the patients’ facial pain. Authors’ analysis of the factors that were involved in optimum result from MVD showed that the following factors correlated positively with better postoperative outcome:

1. Shorter duration of symptoms,
2. Typical presentation as opposed to having atypical trigeminal neuralgia,