A "Reposition Technique" Microvascular Decompression in Trigeminal Neuralgia: Clinical Outcomes and Complications

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Background: *Microvascular decompression (MVD) is effective for pain relief. Previous studies reported modifications of operative technique.*
Objective: *To assess the clinical outcomes and complications of patients diagnosed with primary typical trigeminal neuralgia underwent MVD with reposition technique.*
Material and Method: *From 2009 to 2015, 32 patients underwent MVD by a single surgeon at Prasat Neurological Institute. The authors performed a retrospective chart review. Visual Analogue Scale (VAS) and Barrow Neurological Institute Pain Scale (BNI-PS) were used to analyze the pain intensity pre-operatively and 6 months postoperatively comparing the two operative techniques.*
Results: *Patients experienced significant improvement in both VAS and BNI-PS after MVD in both techniques. The reposition technique declared higher difference VAS compared with traditional technique (6.84 vs. 5.0, p = 0.008), whereas blood loss was significantly higher.*
Conclusion: *Overall, two different techniques provide positive outcomes of pain relief. The authors suggested the optional technique of MVD that would rather restrain the offending vessel than placing the Teflon sponge.*

Keywords: *Microvascular decompression, Trigeminal neuralgia, Reposition technique, Interposition technique, Visual Analogue Scale, Barrow Neurological Institute Pain Scale*

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Trigeminal neuralgia (TN) is a facial pain syndrome characterized by paroxysmal, shock-like pain attacks located in the somatosensory distribution of the trigeminal nerve. The prevalence of TN in the general population is 0.015%[1]. TN is uncommon in population younger than 40 years and increases in incidence with advancing age. TN appears to be slightly more common among women[2].

Most experts agree that the etiology is segmental demyelination of trigeminal sensory nerves in the nerve root or brainstem, and the demyelination is due to chronic compression of the nerve root where it exits from the pons. Most theories consider vascular compression at the root entry zone as the cause[3-6].

Since Jannetta's original description of the microvascular decompression approach via a retrosigmoid craniectomy in the 1970s, there have been several modifications and elaborations to the technique, particularly in the method of maintaining the separation of the nerve and the offending vessel. A dural sling is fashioned from the tentorium cerebelli to suspend the vessel away from the trigeminal nerve[7-10]. The reported pain-free duration without medication after MVD ranged from 0.6 years to 10 years. Previous studies reported that MVD with traditional technique was effective for the relief of pain and improved the patient's quality of life[11]. Roger et al (1996) reported complete resolution of facial pain in 6 patients who underwent a tentorial sling in MVD[12]. But there was no study reporting the comparative effect of pain relief between these 2 techniques. This study aimed to compare the effectiveness between the 2 techniques, in terms of pain relief, evaluated the clinical outcomes and complications, and assessed the factors related to the procedure.

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Material and Method

A total of 32 patients with a diagnosis of refractory trigeminal neuralgia[24] were referred for surgical treatment. The patients were only with primary typical TNs and clear-cut vascular compression of the root found intra-operatively. The data were collected from medical records, MRI findings and operative notes from October 2009 to September 2015. All patients were operated on by a single surgeon in Prasat Neurological Institute.

The basic characteristics of the patients were documented, including gender, age at the onset of symptoms, duration of symptoms, age at surgery, distribution of pain, side symptoms, pre-operative facial numbness, underlying diseases and MRI verification of vessel compression. The image was interpreted by neurosurgeon and neuroradiologist.

Primary typical TN is determined by: 1) pain limited to the distribution of one or more divisions of the trigeminal nerve; 2) paroxysmal attacks of pain lasting from a fraction of a second to two minutes; 3) pain has at least one of the following characteristics; (A) intense, sharp, burning, superficial, or stabbing, (B) precipitated from trigger areas or by trigger factors; 4) Attacks are stereotyped to the individual patient.

All cases attempted to perform the reposition technique, depending on the operative findings. All patients were followed-up at least six months after surgery.

Surgical technique

The patient was in the park-bench position with the head fixed in a Mayfield-Kees headrest. The skin incision was made 2.5 cm behind the retroauricular hairline. The nuchal fascia was incised in the same direction, and sternocleidomastoid, trapezius, splenius capitis, longissimus capitis, and superior obligue muscles were partially dissected from their attachments, and retracted laterally, exposing the asterion. A small craniotomy was performed, and the dura was opened in a semilunar shape. An intradural dissection led to the superior cerebellopontine angle cistern. Care was taken to avoid disturbing the facial-vestibulocochlear nerve complex. The trigeminal nerve was identified, and dissected from the surrounding arachnoid membranes, looking for an offending vessel.

The offending vessel was identified and the compressing loop was carefully dissected away from the trigeminal nerve. Vascular reposition was attempted in all cases, by evaluating the vascular feature and torsuosity. A pedicle of tissue obtained from the undersurface of the tentorium cerebelli was used to restrain the offending vessel as the restraining sling (Fig. 2). Care was taken to ensure that the vessel was not kinked. If the reposition technique could not be performed in case of short vessel loop or venous compression, the interposition technique was used by placing the Teflon sponge between the offending vessel and trigeminal nerve (Fig. 3).

Assessment of the outcomes

Demographic data, clinical background, operative finding and clinical outcome including

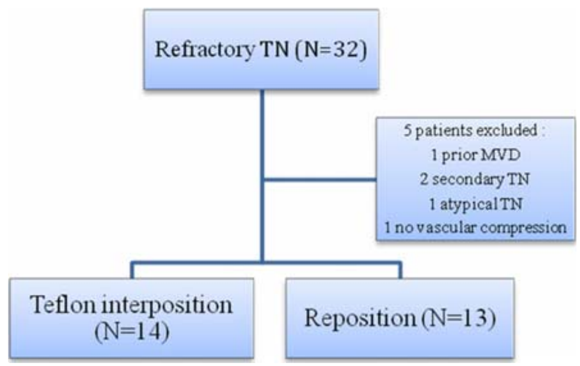

Fig. 1 Flow diagram of patient selection and divided into 2 groups.

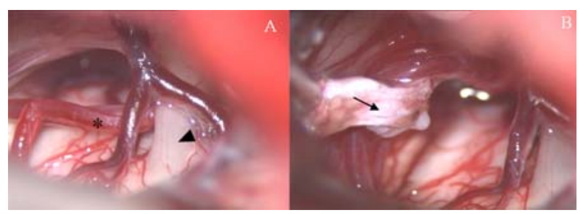

Fig. 2 A) The intraoperative photographs show the offending vessel (*), the superior cerebellar artery (SCA), was visualized, compressing the root exit zone of the trigeminal nerve (arrow head). B) The dural sling (arrow) was prepared from the undersurface of the tentorium cerebelli and passed underneath the SCA.

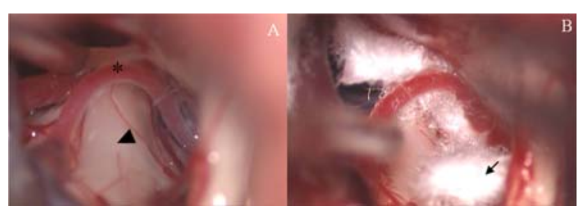

Fig. 3 A) The intraoperative finding of SCA compression (*) at the root exit zone of the trigeminal nerve (arrow head). B) The Teflon sponge (arrow) was interposed between the trigeminal nerve and SCA.

complication were analyzed. Visual Analog Scale (VAS) and the Barrow Neurological Institute Pain Scale (BNI-PS) were used to measure the pain intensity (Table 1).

Pre-operative VAS and BNI-PS were determined by the maximal pain intensity that patient experienced before admit for surgery. Postoperative VAS and BNI-PS were determined by the maximal pain intensity of the same characteristic as preoperative symptoms at the period before discharge and at six-month follow-up.

Improvement of symptoms was determined by the difference of VAS and BNI-PS between pre-operative and postoperative periods.

Statistical analysis

Data analysis was performed using SPSS for windows version 16.0. Results were expressed as percentages for qualitative data and means for quantitative data. Comparisons were performed using the Chi-square test and Fisher's exact test for parametric data and Mann-Whitney's U test for nonparametric data.

Results

From October 2009 to September 2015, 32 patients were admitted to the Department of Neurosurgery of Prasat Neurological Institute for the treatment of medicine refractory TN (Fig. 1). In all, five patients were excluded: two were presented with tumor-caused TN, one had atypical TN, one had prior surgery due to TN, and one had no vascular compression. Thus 27 patients with primary typical TN were enrolled to this study: 14 patients underwent microvascular decompression with conventional technique using Teflon sponge; 13 patients underwent microvascular decompression with reposition technique.

The patients' mean age at onset of symptom was 51.8±13.4 years in Teflon interposition group, and 49.7±15.4 years in reposition group. 28.6% of patients in the interposition group was male, and 53.8% in reposition group. The mean pre-operative duration of symptoms was 91.4 months (range 6-480 months) in interposition group, and 77.7 months (range 12-192 months) in reposition group. The mean age at surgery was 59.3±10.8 years in interposition group, and 56.3±15.7 years in reposition group. The patients' demographic data and characteristics are summarized in Table 2.

Table 1. Barrow Neurological Institute Pain Score

Score	Description
I	No pain, no medication
II	Occasional pain, not requiring medication
III	Some pain, adequately controlled with medication
IV	Some pain, not adequately controlled with medication
V	Severe pain/no pain relief

The mean preoperative VAS was 6.93 (range 3-9) in interposition group and 8.38 (range 5-10) in reposition group. There were no significant differences in pre-operative VAS between two groups ($p = 0.068$). The median preoperative BNI score was 4 in both the interposition group and the reposition group with no significant differences between two groups ($p = 0.695$). In terms of outcome of surgery, the mean pre-operative and postoperative VAS was 6.93 and 1.93 in interposition group, and 8.38 and 1.54 in reposition group. There was no significant difference in pre-operative and postoperative VAS between two groups ($p = 0.068$, and $p = 0.246$). The mean difference of VAS was 5.0 in interposition group, and 6.84 in reposition group, which reached statistical significance ($p = 0.008$) (Table 3). The mean pre-operative and postoperative BNI were 4.0 and 1.0 in both groups; thus, there was no significant difference in pre-operative and postoperative BNI, as the difference of BNI in both groups.

The mean operative time was 153.07 minutes (range 99-220 minutes) in reposition group, and 156.38 minutes (range 110-223 minutes) in reposition group, with no significant difference between two groups ($p = 0.734$). Blood loss was significantly higher in the reposition group ($p = 0.001$), with an average amount of 110.77 ml compared with 31.79 ml in the interposition group.

For hospital stay, there was no significant difference between the two groups ($p = 0.246$). In terms of complication related to surgery, in the interposition group, one patient had postoperative facial numbness, and one patient had urinary tract infection. In the reposition group; one patient had wound infection with improved after medical treatment. No patients experienced cerebrospinal fluid (CSF) leakage, stroke, or death.

The intra-operative finding of vessel compression was shown (Table 4). Most of the patients in two groups had the superior cerebellar artery (SCA) compression with no significant differences. Venous compression was shown in one patient for the

Table 2. Characteristics and findings in patients with primary trigeminal neuralgia

Characteristic	Operation		*p*-value
	Telfon interposition (n = 14) (%)	Reposition (n = 13) (%)	
Gender			
Male	4 (28.6)	7 (53.8)	0.182
Age at onset of symptom (mean) (years)	51.8	49.7	0.716
Preoperative duration of symptoms (mean) (months)	91.4	77.7	0.283
Age at surgery (mean) (years)	59.3	56.3	0.544
Underlying disease			
None	6 (42.9)	8 (61.5)	0.332
Hypertension	6 (42.9)	4 (30.8)	0.695
Diabetes	1 (7.1)	1 (7.7)	1.000
Dyslipidemia	3 (21.4)	4 (30.8)	0.678
Others	1 (7.1)	1 (30.8)	1.000
Side of symptom, Rt	7 (50)	9 (69.2)	0.310
Distribution of pain			
V1 only	0	0	
V2 only	3 (21.4)	1 (7.7)	
V3 only	2 (14.3)	2 (15.4)	
V1 & V2	3 (21.4)	2 (15.4)	0.815
V2 & V3	4 (28.6)	6 (46.2)	
V1, V2 & V3	2 (14.3)	2 (15.4)	
Preoperative facial numbness	2 (14.3)	5 (38.5)	0.209
MRI verification of vessel compression	6 (42.9)	4 (30.8)	0.695
Preoperative VAS (mean)	6.93	8.38	0.068
Preoperative BNI-PS score			
I-III	0	0	
IV	10 (71.4)	8 (61.5)	0.695
V	4 (28.6)	5 (38.5)	

VAS = Visual Analogue Score; BNI-PS = Barrow Neurological Institute Pain Scale

interposition group, and two patients for the reposition group.

Discussion

Microvascular decompression of the trigeminal nerve is a major neurosurgical procedure offered to patients who suffer from trigeminal neuralgia when other less invasive treatment options are either no longer helpful or contraindicated.

In terms of clinical outcome, from the previous published results, the success rate at 5 years ranged from 63% to 86%. In the largest reported series of 1,204 patients, Barker D et al, 69.9% of the patients had excellent results 10 years after MVD. In other publications with Kaplan-Meier analyses, such as those by Broggi et al, Zakrzewska et al[16], Bederson and Wilson[5], and Tronnier et al[15], the cures rate were 84.7% at 3.2 years, 84% at 5 years, 75% at 5.1 years, and 63% at 10.9 years, respectively[13-16]. Jyi-Feng Chen et al, immediate pain relief was reported in up to 98.5% of trigeminal neuralgia patients who underwent microvascular decompression[10,16-18]. In our study, immediate pain relief was 88.89%. It has been reported that patients with typical TN and immediate postoperative remission have more often an excellent/ good postoperative outcome, being the immediate postoperative remission an independent predictive factor for good long-term outcome. However, the cure rate dropped during the follow-up period[15].

Recurrent rates have been reported of 6% to 38% in more than 5 years of follow-up[7,10,17]. Most postoperative recurrences of trigeminal neuralgia take place in the first 2 years after surgery. The reported annual recurrence rate was from 1% to 3.5%[13,19]. In

Table 3. Outcomes of Microvascular decompression

Characteristic	Operation		*p*-value
	Telfon interposition (n = 14)	Reposition (n = 13)	
Preoperative VAS (mean)	6.93	8.38	0.068
Postoperataive VAS (mean)	1.93	1.54	0.246
Difference of VAS	5.00	6.84	0.008
Preoperative BNI (mean)	4.0	4.0	0.695
Postoperative BNI (mean)	1.0	1.0	1.000
Difference BNI	3.0	3.0	1.000
Operative time (mean) (minutes)	153.07	156.38	0.734
Blood loss (mean) (ml)	31.79	110.77	0.001
Hospital stay (mean) (day)	8.71	8.08	0.246
Complications			
No	12	12	
Facial numbness	1	0	0.617
Infection	1	1	
Stroke	0	0	

VAS = Visual Analogue Score; BNI = Barrow Neurological institute

Table 4. Vessel compression discovered at operation

Characteristic	Operation		*p*-value
	Telfon interposition (n = 14) (%)	Reposition (n = 13) (%)	
Artery			
SCA	13 (92.9)	12 (92.3)	1.000
AICA	4 (28.6)	2 (15.4)	0.648
Vein	1 (7.1)	2 (15.4)	0.596

SCA = Superior Cerebellar artery; AICA = Anterior Inferior Cerebellar artery

our study, 4 patients (14.8%) had the recurrent of symptoms which could be controlled with medical treatment during the follow-up period. In the previous studies, the several factors that might be the result of recurrence were these followings; arachnoid adhesions, Teflon granuloma, new vascular loop, venous compression, arachnoid cyst and negative finding. The arachnoid adhesions was found in 80% and 5.6% was Teflon granuloma. The Teflon felt can induce an inflammatory giant-cell foreign body reaction and can produced complications[20].

In terms of pain measurement, The Visual Analog Scale (VAS) and the Barrow Neurological Institute Pain Scale (BNI-PS) are 2 of the most frequently employed patient-reported outcome tools to rate pain for patients with trigeminal neuralgia. Vishruth KR et al[21], reported the Minimum clinically important difference (MCID) calculation that provides a point estimate of the clinical threshold needed to achieve clinical relevant treatment effectiveness. The average MCID for VAS is 6.25 and for BNI-PS is 2.44. In our study, the difference of VAS was 6.84 in reposition group, whereas the difference VAS of interposition group was 5.00. With this application, the reposition technique may achieves the effectiveness of treatment. However, it cannot be indicated that the reposition technique was better than the traditional technique.

In terms of operative technique, the operative time between 2 techniques did not reach the statistical significant (153.07 minutes vs. 156.38 minutes) because of the surgeon’s expertise and all cases were attempted to perform the reposition technique initially. Time spent during vascular dissection and evaluation of vessel features was the result of equal operative time. The amount of blood loss in reposition group was significantly higher than interposition group, which correspond with the previous reported study. Bleeding from the venous channel during the tentorial dissection may resulted in higher blood loss in reposition technique(12).

The factors related to the patient's outcomes were typical trigeminal neuralgia; clear-cut vascular compression, high degree of NCV, single vessel compression, arterial compression and no vein compression were the positive prognostic factors(22,23). In our study, all patients were diagnosed the primary typical trigeminal neuralgia which confirmed vessel compression if the trigeminal nerve intra-operatively; thus, the patient's characteristics were similar in both groups.

In terms of surgical complications, previous studies described complications after this procedure to be infections, facial palsy, facial numbness, cerebrospinal fluid leakage, hearing deficit and stroke with a mortality of 0.1%(14). In this study, 1 patient had postoperative facial numbness and 1 patient had urinary tract infection in interposition group. One patient from reposition group experienced surgical site infection which improved after medical treatment. No patients had the stroke event or death, which was the most serious risks from vessel kinking or injury especially with the reposition technique.

In this study, the mean follow-up time was 6.4 months (range 6-19 months) and the cure rate was 88.89%. Although the follow-up period was quite short, comparing to the previous reported studies, the immediate postoperative remission was high. Compatible with the previous study reported that the immediate postoperative remission is an independent predictive factor for good long-term outcome(15). However, longer follow-up period should be done for the additional data and results.

Limitations

There are several limitations in this study. First, this study was the retrospective study. All patient data were reviewed and collected from the medical records, MRI reports and operative notes. Some data may have been missing or lack details. Second, this study was reviewed in patients operated on by a single surgeon. Although the factors related to the operative technique and decision making were limited, the small sample size were unavoidable. Further study with longer period and more sample size are needed. Third, because of the short follow-up period, the results about long-term outcomes and recurrent rate could not be collected and analyzed. Furthermore, longer follow-up periods are suggested for gathering additional data and results.

Conclusion

Microvascular decompression provides pain relief and is effective in patients with trigeminal neuralgia. With the principle of separating of the offending vessel from the trigeminal nerve, modification by operative technique has been presented. This study showed significant difference in clinical improvement between the two techniques, however, it cannot be concluded that which technique is better. Because of the significant clinical improvement in both techniques, the authors suggested the optional technique of microvascular decompression that would rather restrain the offending vessel than placing a Teflon sponge.

What is already known on this topic?

There were many studies evaluating the efficacy, cure rate and quality of life of MVD that published before. The surgical technique of tentorial sling was introduced by Roger et al in 1996 with complete resolution of facial pain in six patients.

What this study adds?

Nowadays, there is no published study evaluating the outcome and complication of the reposition technique in MVD. Moreover, there are no reported data that compare the clinical outcomes between the reposition technique with traditional technique.

Potential conflicts of interest

None.

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การเปรียบเทียบผลการรักษาและภาวะแทรกซ้อนในการผ่าตัดผู้ป่วยโรคปวดเส้นประสาทใบหน้าด้วยวิธีการผ่าตัดย้ายตำแหน่งเส้นเลือด

พีรุตม์ ศิวเวทพิกุล, อนุศักดิ์ เลียงอุดม

วัตถุประสงค์: *การผ่าตัด microvascular decompression (MVD) เป็นวิธีการรักษาที่ได้ผลดีในเรื่องการลดอาการปวด จากการศึกษาที่ผ่านมาพบว่ามีเทคนิคในการผ่าตัดมีความหลากหลาย ผู้นิพนธ์ต้องการที่จะศึกษาผลของการรักษาและภาวะแทรกซ้อนในผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็น primary trigeminal neuralgia ซึ่งได้รับการผ่าตัด microvascular decompression ด้วยวิธี reposition technique*

วัสดุและวิธีการ: *ผู้นิพนธ์รวบรวมผู้ป่วยตั้งแต่ปีพ.ศ. 2552 ถึง พ.ศ. 2558 มีผู้ป่วยทั้งหมด 32 คน ซึ่งได้รับการผ่าตัดโดยศัลยแพทย์คนเดียวกัน ผู้นิพนธ์ได้ศึกษาโดยเก็บข้อมูลจากเวชระเบียน โดยประเมินระดับความเจ็บปวดด้วย Visual Analog Scale (VAS) และ Barrow Neurological Institute Pain Scale (BNI-PS) เปรียบเทียบการผ่าตัด 2 กลุ่มทั้งก่อนและหลังผ่าตัด และที่ระยะการตรวจติดตามที่ 6 เดือน*

ผลการศึกษา: *พบว่าทั้ง 2 กลุ่มมีผลการผ่าตัดที่มีประสิทธิภาพในด้านการลดอาการเจ็บปวดใบหน้าอย่างมีนัยสำคัญทางสถิติ ซึ่งการผ่าตัดด้วยวิธี reposition technique มีความแตกต่างของ VAS มากกว่าอย่างมีนัยสำคัญทางสถิติเมื่อเปรียบเทียบกับกลุ่มที่ผ่าตัดแบบเดิม แต่มีการเสียเลือดปริมาณมากกว่าอย่างมีนัยสำคัญทางสถิติ*

สรุป: *การผ่าตัดทั้ง 2 วิธีให้ผลเรื่องการลดอาการเจ็บปวดใบหน้าได้ดี ถึงแม้ว่าในทางสถิติการผ่าตัดด้วยวิธี reposition จะทำให้อาการปวดลดลงได้มากกว่า แต่ในทางปฏิบัติผู้นิพนธ์เพียงต้องการนำเสนอทางเลือกในการผ่าตัด microvascular decompression ในกรณีที่ผู้รักษาไม่ต้องการให้มีการสัมผัสของวัสดุกับเส้นประสาท*