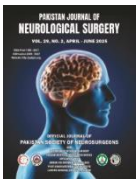

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Original Research

Clinical Outcome of Microvascular Decompression In The Management Of Trigeminal Neuralgia In A Single Center: A Prospective Study

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ABSTRACT

Objectives: In the cases of trigeminal neuralgia unresponsive to medication or conservative measures, microvascular decompression is the preferred surgical technique. The objective of the current study was to evaluate the clinical outcomes of the microvascular decompression technique in the management of TN.

Material & Methods: This prospective, observational study spanned over two years from January 2021 to December 2022. Adults diagnosed with typical TN who were at least eighteen years old, and who were not responding to conservative treatment options, including carbamazepine and gabapentin, were enrolled in the study. The assessment of pain was performed using the Visual Analog Scale (VAS) and the Barrow Neurological Institute (BNI) pain intensity scale.

Results: The mean age of the patients was 52.4 ± 10.2 years, with a range from 32 to 74 years. On the assessment before surgery, the mean VAS score was 8.6 ± 1.1, and twenty of the patients (74.1%) had severe pain (VAS ≥ 8). While twenty-four patients (89%) scored IV or V on the BNI scale, indicating severe pain. The mean postoperative VAS lowered to 1.9 ± 0.8 ($p < 0.001$) at the 1-year follow-up.

Conclusion: With a low risk of complications and significant pain reduction, microvascular decompression is the safe and efficient treatment option. For patients with refractory TN, MVD should remain the first-choice surgical treatment because of its good results and low morbidity rate.

Keywords: Microvascular decompression, postoperative pain relief, superior cerebellar artery, trigeminal neuralgia, vascular compression.

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INTRODUCTION

Trigeminal neuralgia is a clinical entity characterized by the hallmark of excruciating face pain in the trigeminal nerve's distribution, usually brought on by innocuous stimuli. The pain is sharp, stabbing, intermittent, recurrent, cutting, and transient.[1] Nicolas André initially referred to TN as "tic douloureux" in 1756.[2] Reports on the incidence of TN range from 4.3 to 27 new cases per 100,000 individuals per year[3,] making it a rare condition. According to studies on its prevalence, TN affects 0.03–0.3% of people in the general population.[4] Compared to men, women are more frequently affected. Age is a factor in incidence, with 53 being the average age at which TN onset normally occurs.[5]

The first line of action for TN should be conservative treatment, according to worldwide guidelines. Antiepileptic medications (AEDs) including carbamazepine (CBZ) gabapentin, and pregabalin are commonly recommended as supported by the study conducted by Prisco et al, 2011.[6] In monotherapy or polytherapy regimens, additional medications like baclofen, pregabalin, and gabapentin (GBP) are also advised. About 70% of patients will have pain control with conservative treatment in the early stages of the disease. However, drugs lose their effectiveness with time, and sometimes side effects force the discontinuation of medical treatment. As a result, approximately half of the patients suffering from TN eventually need surgery to relieve the associated symptoms.[7,8]

Microvascular decompression (MVD), PBC (Percutaneous balloon compression), percutaneous glycerol rhizotomy (PGR), percutaneous radiofrequency rhizotomy (PRR), and stereotactic radiosurgery (SRS) are among the surgical interventions for TN.[9] TN is now thought to be caused by vascular compression, according to Dandy's theory. This theory has led to the widespread acceptance of microvascular decompression (MVD) as a common and sensible technique for the treatment of primary TN, in part because of its superior pain management capabilities.[10] Relieving the trigeminal nerve's vascular compression is the aim of MVD. Prior MVD research indicates that 71–80% of patients experience no pain at all during long-term follow-up and that individuals without concurrent chronic pain had better outcomes.[11,12] Meningitis, stroke, cranial nerve dysfunction, leaking of cerebrospinal fluid, and mortality are among the complications associated with MVD, It entails delicate posterior fossa surgery where the brainstem, cranial nerves, and cerebellum are partially exposed.[13]

The objective of the current study was to evaluate the clinical outcomes of the microvascular decompression technique in the management of TN.

MATERIALS AND METHODS

Study Design/Setting/Duration

This prospective, observational study spanned over two years from January 2021 to December 2022 at the tertiary care Hospital, Prime Teaching Hospital, Peshawar. The Institutional Review Board granted the ethical approval for the study (Ref no: Prime/IRB/2022-465).

Patient Selection

Patients were recruited for the study based on pre-established inclusion and exclusion criteria. Adults diagnosed with typical TN who were at least eighteen years old and were not responding to standard medical treatment, such as carbamazepine and gabapentin, were included in the study. Patients were enrolled after the preoperative examination confirmed the diagnosis. Those diagnosed with conditions leading to TN including multiple sclerosis or tumours were excluded.

Pre-operative Assessment

Before opting for surgical intervention, a detailed preoperative assessment consisting of subjective

and objective examination along with radiological imaging was performed. MRI was used to evaluate the neurovascular abnormalities while ruling out the secondary causes of TN. The assessment of pain was performed using the Visual Analog Scale (VAS) and the BNI pain intensity scale.

Surgical Procedure

Using a consistent MVD approach, the same skilled neurosurgeon carried out all surgical procedures. The patient was positioned laterally during the general anesthesia procedure. The cerebellopontine angle was exposed via a suboccipital craniotomy that was performed after a retroauricular incision. After identifying the trigeminal nerve, Teflon felt was used to carefully mobilize the compressing vascular structure—distance from the nerve, usually the superior cerebellar artery. Before the incision was closed, hemostasis was guaranteed, and saline irrigation was applied to the operating field. Following surgery, patients had to spend a full day under observation in the intensive care unit before being moved to the ward to receive additional care.

Follow-up and Outcome Measures

Patients underwent follow-up at predetermined intervals, namely one week, one month, six months, and one year following surgery. The VAS was used to quantify pain alleviation and monitor changes in pain severity. The main outcome measure of our study was to note the degree of pain relief associated with TN, which was measured by a minimum of 50% reduction in pain intensity on the VAS scale or obtaining a BNI score of I, which denotes no discomfort and no need for further use of medications for pain relief. The occurrence of surgical complications such as face numbness and cerebrospinal fluid leaks, the progression of cranial nerve impairments, and the return of symptoms were also noted.

Table 1: *Patient Demographics and Clinical Characteristics.*

Characteristic	Frequency (n = 27)	Percentage (%)
Age (mean ± SD)	52.4 ± 10.2 years	-
Gender		
- Male	12	44.4
- Female	15	55.6
Affected Side		
- Right	18	66.7
- Left	9	33.3
Pain Distribution		
- Mandibular (V3)	16	59.3
- Maxillary (V2)	8	29.6
- Ophthalmic (V1)	3	11.1
Duration of Symptoms (mean ± SD)	5.1 ± 2.3 years	-

Data Analysis

A consistent proforma was used to gather the data, which were then input into SPPS version 26 for analysis. Descriptive statistics were used to summarize the preoperative pain levels, clinical outcomes, and demographic characteristics. Continuous values were displayed as mean ± standard deviation, whereas categorical variables were displayed as frequencies and percentages. Preoperative and postoperative VAS values were compared using paired t-tests to examine pain outcomes; categorical variables and complication rates were assessed using chi-square testing. The threshold for statistical significance was less than 0.05.

RESULTS

Patient Demographics and Clinical Characteristics

Twenty-seven individuals with TN underwent microvascular decompression (MVD) over the two-year trial period. The mean age was 52.4 ± 10.2 years, with a range of 32 to 74 years. Males constituted twelve (44%) of the sample while fifteen (56%) were females. 18 patients (66.7%) with TN (the right side) and 9 patients (33.3%) with

the left side were afflicted. With 16 patients (59.3%), the mandibular (V3) region showed the highest prevalence of pain distribution. This was followed by the maxillary (V2) region with 8 patients (29.5%) and the ocular (V1) region with 3 patients (11.1%). Before surgery, the symptoms persisted for an average of 5.1 ± 2.3 years.

Preoperative Pain Scores

Before surgery, the mean VAS score was 8.6 ± 1.1, and twenty patients (74.1%) reported having severe pain (VAS ≥ 8). 22 patients (82%) had BNI scores of IV or V, indicating severe pain that required substantial dosages of medication.

Table 2: *Preoperative pain scores.*

Preoperative Pain Assessment	Frequency (n = 27)	Percentage (%)
VAS Score (mean ± SD)	8.6 ± 1.1	-
Patients with VAS ≥ 8	20	74
BNI Pain Scale		
- Grade IV or V	22	82

Intraoperative Findings

During the surgery, it was found that each patient had a vascular loop pinching their trigeminal nerve. The superior cerebellar artery (SCA) was the most frequently offending vascular, causing nerve compression in 21 patients (77.8%). The anterior inferior cerebellar artery (AICA) was identified as the principal compressing vascular in 4 individuals (14.8%), whereas the SCA and AICA both contributed to compression in 2 patients (7.4%). There were no reports of tumors or any secondary causes of TN.

Table 3: *Intraoperative findings.*

Intraoperative Findings	Frequency (n = 27)	Percentage (%)
Superior Cerebellar Artery (SCA)	21	77.8
Anterior Inferior Cerebellar Artery (AICA)	4	14.8
Combined (SCA + AICA)	2	7.4

Postoperative Pain Relief and Success Score

The mean postoperative VAS score has dramatically lowered to 1.9 ± 0.8 ($p < 0.001$) at the 1-year follow-up. In 24 patients (89%), total or nearly complete pain alleviation (BNI Grade I or II) was noted. During the follow-up period, two patients (7%) reported mild discomfort (BNI Grade III), while one patient experienced a recurrence of severe pain (BNI Grade IV or V).

The overall success rate of MVD was 89%, which was characterized by significant pain reduction (BNI Grade I or II) without serious complications. During the follow-up period, all patients resumed their regular daily activities with no mortalities reported. No case of recurrence was reported throughout the study period.

Table 4: *Post-Operative Pain Relief.*

Parameter	Preoperative	Postoperative	p-value
VAS Score (mean ± SD)	8.6 ± 1.1	1.9 ± 0.8	0.002
BNI Pain Scale			
- Grade IV or V	22 (82%)	1 (4%)	<0.001
- Grade I or II	2 (7%)	24 (89%)	<0.001
- Grade III	3 (11%)	2 (7%)	<0.001

Complications and Cranial Nerve Deficits

Observations of postoperative complications included 5 patients (18.5%). Three cases (11.1%) were reported complaining of mild facial numbness while two patients had CSF leaks. These complications were treated conservatively.

DISCUSSION

One of the most effective surgical techniques utilized for treating TN is microvascular

Table 5: *Complications of the procedure.*

Complications	Frequency (n = 27)	Percentage (%)
Cerebrospinal Fluid Leak	2	7.4
Facial Numbness	3	11.1

decompression (MVD), especially in those suffering from neurovascular compression symptoms. A greater extent of pain relief along with few adverse effects was observed in this study, which is following previous studies.

The score of I and II measured on the BNI scale was achieved by 89% of our sample indicating the satisfactory outcomes of the surgical procedure. The findings of our study are supported by the work done by Reddy, Vishruth K, and colleagues who reported that after undergoing microvascular decompression the participant's pain level significantly decreased when measured on both scales VAS (9.9 vs. 2.0, P<.001) and BNI-PS (5.0 vs. 1.9, P<.001).[14] Another study conducted to determine the results of MVD following surgery also showed that 8 patients had complete symptom alleviation after 2 weeks, whereas 78.8% of patients had received immediate improvement.[15] These results provide evidence to the theory that, in cases where there is obvious vascular compression of the trigeminal nerve, MVD is still the best course of treatment for TN in cases which are refractory to conservative treatment.

Compared to men, women (n 15 56%) made up the majority of study participants diagnosed with refractory TN while V2 (8 30%) and V3 (16 59%) nerve branches were the most frequently impacted (67.8%). The female-to-male ratio was 5:3, according to the findings of a study done to determine the range of microvascular decompression for the trigeminal nerve. The most often affected branches were V2 and V3 (40%), followed by V2 (27.5%), V3 (25%), and V1 V2 (7.5%).[16] Although the reason for the increased occurrence in females is unknown, changes in estrogen levels during the menstrual cycle may be a contributing factor. However, there isn't a clear explanation for why a particular nerve branch is involved in nerve injuries. Our findings showed that the most common etiology of TN (21.78%) was the superior cerebellar artery loop. A case series conducted in Kengeri between 1995 and 2007 also showed that in 71.5% of the cases, the superior cerebellar artery was found to be the most common cause following surgery. The same etiological component is also depicted in other research.[17,18] Because the superior cerebellar artery is located close to the trigeminal nerve's root entry zone, it is often implicated. Furthermore, we noted that 7% of patients had involvement of both the anterior inferior cerebellar artery (AICA) and SCA, whereas 15% of patients experienced compression by the AICA. These results emphasize the significance of a thorough intraoperative vascular examination because several arteries may be responsible for the compression of the trigeminal nerve.

Even though MVD offers great results in terms of pain management and patient satisfaction, there are occasionally more severe consequences like mortality and some post-surgical problems. According to our analysis, the most frequent MVD complication was CSF fluid leak, which affected 2 (7%) of the patients, and facial numbness in 3 (11%) of the patients.[19] Other MVD-related complications include muscle atrophy, hearing loss, vascular and cerebellar damage, CSF leak, and sensory abnormalities, according to several studies. In contrast to our findings, a study done to ascertain the problems related to MVD showed a 1.4% rate of CSF leakage but no death rate was provided.[20] The literature demonstrated permanent hearing loss as a result of MVD. Two individuals experienced persistent ipsilateral analysis, and 1.9% of patients experienced hearing impairments following the treatment, according to a study done to identify the complications related to MVD.[21] However, in contrast, our study showed no such complications. Our study's low rate of complications may be due to the use of intraoperative monitoring to reduce damage to

nearby structures, precise microsurgical procedures, and cautious patient selection. To provide the best possible results and reduce postoperative morbidity, these elements are of paramount importance.

There are a few limitations to consider. The limited sample size of 27 patients may constrain the generalizability of our results. Furthermore, the one-year follow-up period can miss long-term recurrence rates, which can happen several years following MVD. To determine the possibility of a late recurrence and to verify the sustainability of pain alleviation, more research with bigger patient cohorts and longer follow-up times is required.

CONCLUSION

It is concluded that for TN, a safe and efficient treatment option with a low risk of consequences and significant pain reduction is microvascular decompression. For patients with refractory TN, MVD should remain the first-choice surgical treatment because of its good results and low morbidity rate.

REFERENCES

1. Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. Cephalalgia. 2018;38(1):1-211. Doi: 10.1177/0333102417738202. PMID: 29368949.
2. Cole CD, Liu JK, Apfelbaum RI. Historical perspectives on the diagnosis and treatment of trigeminal neuralgia. Neurosurgical focus. 2005;18(5):1-0. Doi: 10.3171/foc.2005.18.5.5
3. Cheshire Jr WP. Trigeminal neuralgia: diagnosis and treatment. Current neurology and neuroscience reports. 2005;5(2):79-85. Doi: 10.1177/0333102416687280
4. De Toledo IP, Réus JC, Fernandes M, Porporatti AL, Peres MA, Takaschima A, Linhares MN, Guerra E, Canto GD. Prevalence of trigeminal neuralgia: A systematic review. The Journal of the American Dental Association. 2016;147(7):570-6. Doi: 10.1016/j.adaj.2016.02.014
5. Katusic S, Beard CM, Bergstralth E, Kurland LT. Incidence and clinical features of trigeminal neuralgia, Rochester, Minnesota, 1945–1984. Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society. 1990;27(1):89-95. Doi: 10.1002/ana.410270114
6. Prisco L, Ganau M, Bigotto F, Zornada F. Trigeminal neuralgia: successful antiepileptic drug combination therapy in three refractory cases. Drug, Healthcare and Patient Safety. 2011:43-5. Doi: 10.2147/DHPS.S22385
7. Bendtsen L, Zakrzewska JM, Abbott JA, Braschinsky M, Di Stefano G, Donnet A, Eide PK, Leal PR, Maarbjerg S, May A, Nurmikko T. European Academy of Neurology guideline on trigeminal neuralgia. European journal of neurology. 2019;26(6):831-49. Doi: 10.1111/ene.13950.
8. Di Stefano G, La Cesa S, Truini A, Cruccu G. Natural history and outcome of 200 outpatients with classical trigeminal neuralgia treated with carbamazepine or oxcarbazepine in a tertiary centre for neuropathic pain. The journal of headache and pain. 2014;15:1-5. Doi: 10.1186/1129-2377-15-34
9. Bick SK, Eskandar EN. Surgical treatment of trigeminal neuralgia. Neurosurgery Clinics. 2017 Jul 1;28(3):429-38. Doi: 10.1016/j.nec.2017.02.009.
10. Patel SK, Markosian C, Choudhry OJ, Keller JT, Liu JK. The historical evolution of microvascular decompression for trigeminal neuralgia: from Dandy's discovery to Jannetta's legacy. Acta Neurochirurgica. 2020;162:2773-82. Doi: 10.1007/s00701-020-04405-7
11. Sandell T, Eide PK. Effect of microvascular decompression in trigeminal neuralgia patients with or without constant pain. Neurosurgery. 2008;63(1):93-100. Doi: 10.1227/01.NEU.0000335075.16858.EF.
12. Sarsam Z, Garcia-Fiñana M, Nurmikko TJ, Varma TR, Eldridge P. The long-term outcome of microvascular decompression for trigeminal neuralgia. British journal of neurosurgery. 2010;24(1):18-25. Doi: 10.3109/02688690903370289
13. Andersen AS, Heinskou TB, Rochat P, Springborg JB, Noory N, Smilkov EA, Bendtsen L, Maarbjerg S. Microvascular decompression in trigeminal

neuralgia-a prospective study of 115 patients. The Journal of Headache and Pain. 2022;23(1):145. Doi: 10.1186/s10194-022-01520-x
14. Reddy VK, Parker SL, Patrawala SA, Lockney DT, Su PF, Mericle RA. Microvascular decompression for classic trigeminal neuralgia: determination of minimum clinically important difference in pain improvement for patient reported outcomes. Neurosurgery. 2013;72(5):749-54. Doi: 10.1227/NEU.0b013e318286fad2.
15. Jagannath P, Venkataramana N, Bansal A, Ravichandra MJAjon. Outcome of microvascular decompression for trigeminal neuralgia using autologous muscle graft: a five-year prospective study. 2012;7(03):125-30. Doi: 10.4103/1793-5482.103713
16. Chakravarthi PS, Ghanta R, Kattimani V. Microvascular decompression treatment for trigeminal neuralgia. Journal of Craniofacial Surgery. 2011;22(3):894-8. Doi: 10.1097/SCS.0b013e31821a07b7
17. Bangash TH. Trigeminal neuralgia: frequency of occurrence in different nerve branches. Anesthesiology and pain medicine. 2011;1(2):70. Doi: 10.5812/aapm.2164
18. Hardy DG, Rhoton AL. Microsurgical relationships of the superior cerebellar artery and the trigeminal nerve. Journal of neurosurgery. 1978;49(5):669-78. Doi: 10.3171/jns.1978.49.5.0669.
19. Tomasello F, Esposito F, Abbritti RV, Angileri FF, Conti A, Cardali SM, et al. Microvascular decompression for trigeminal neuralgia: technical refinement for complication avoidance. 2016;94:26-31. Doi: 10.1016/j.wneu.2016.06.097.
20. La Torre D, Gorgoglione N, Cafarella D, Romano A, Lavano A, Germanò A, et al. A Novel Technical Refinement of Microvascular Decompression: Pain Relief and Complication Rate in a Consecutive Series of Patients With Trigeminal Neuralgia. 2020. Doi: 10.1093/ons/opaa044.
21. Mastronardi L, Caputi F, Cacciotti G, Scavo CG, Roperto R, Sufianov AJSNI. Microvascular decompression for typical trigeminal neuralgia: Personal experience with intraoperative neuromonitoring with level-specific-CE-Chirp® brainstem auditory evoked potentials in preventing possible hearing loss. 2020;11. Doi: 10.25259/SNI_702_2020

Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
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Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.
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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Akram Ullah, Muhammad Ishfaq, & Abdul Haseeb Sahibzada	1. Study design and methodology.
2.	Muhamamad Younas & Muhammad Zubair	2. Paper writing.
3.	Akram Ullah, Muhammad Ishfaq & Abdul Haseeb Sahibzada	3. Data collection and calculations.
4.	Muhammad Ishfaq, & Bakht Jehan,	4. Analysis of data and interpretation of results.
5.	Akram Ullah, & Muhammad Zubair	5. Literature review and referencing.
6.	Muhammad Zubair & Akram Ullah, Abdul Haseeb Sahibzada	6. Editing and quality insurer.