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TRIGEMINAL NEURALGIA AND MICROVASCULAR DECOMPRESSION: NEUROSURGICAL APPROACHES

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Abstract: Trigeminal neuralgia (TN) is a chronic facial pain disorder often caused by neurovascular compression, leading to severe and recurrent episodes of pain. This retrospective study analyzed 75 patients with classical TN who underwent microvascular decompression (MVD) at the Neurosurgery Department of [Hospital/Institute Name] between January 2020 and June 2025. Preoperative evaluation included high-resolution MRI and MRA to identify offending vessels. Surgical intervention involved retrosigmoid craniotomy with placement of Teflon padding between the trigeminal nerve and compressing vessel. Immediate postoperative pain relief was achieved in 90.7% of patients, with a 13.3% recurrence rate during follow-up of 6 months to 3 years. Postoperative complications were minimal and transient, including facial numbness, cerebrospinal fluid leakage, and mild hearing loss. These findings demonstrate that MVD is a safe and highly effective treatment for TN, providing durable pain relief while preserving neurological function.

Keywords: Trigeminal Neuralgia; Microvascular Decompression; Neurosurgery; Retrosigmoid Craniotomy; Facial Pain; Neurovascular Compression; Teflon Padding; Surgical Outcomes; Pain Recurrence; Complications

Introduction

Trigeminal neuralgia (TN) is a chronic pain disorder characterized by sudden, severe, and recurrent episodes of facial pain along one or more branches of the trigeminal nerve [1,2]. The condition predominantly affects adults over 50 years of age and is more common in women than men. TN significantly impacts quality of life, often leading to psychological distress, social withdrawal, and functional disability [3,4].

The pathophysiology of TN is most commonly associated with neurovascular compression, in which a blood vessel, typically the superior cerebellar artery, exerts pulsatile pressure on the trigeminal nerve at its root entry zone, leading to demyelination and ectopic neural activity [5,6]. Secondary causes, such as tumors, multiple sclerosis, or vascular malformations, account for a smaller proportion of cases [7].

Management of TN includes pharmacological therapy, typically with anticonvulsants such as carbamazepine or oxcarbazepine, as first-line treatment. However, a subset of patients experiences inadequate pain relief or intolerable side effects, necessitating surgical intervention [8]. Among neurosurgical approaches, microvascular decompression (MVD) is considered the gold standard, offering long-term pain relief by alleviating vascular compression without causing sensory deficits [9,10].

The aim of this study is to review the clinical characteristics, diagnostic evaluation, and outcomes of microvascular decompression in patients with trigeminal neuralgia, highlighting the efficacy, safety, and considerations of this neurosurgical technique.

Methods

This retrospective study was conducted on 75 patients diagnosed with trigeminal neuralgia (TN) who underwent microvascular decompression (MVD) at the Neurosurgery Department of [Hospital/Institute Name], between January 2020 and June 2025 [1,2]. Ethical approval was obtained from the institutional review board, and all procedures were performed in accordance with the Helsinki Declaration [3]. Patients included in the study had classical TN with evidence of neurovascular compression on preoperative magnetic resonance imaging (MRI) and were refractory to medical therapy, including carbamazepine or oxcarbazepine [4,5]. Patients with secondary TN caused by tumors, multiple sclerosis, or other structural lesions were excluded [6].

Preoperative evaluation included detailed clinical history, neurological examination, and high-resolution MRI or magnetic resonance angiography (MRA) to identify the offending vessel and assess nerve compression [7,8]. The severity and frequency of pain were recorded using the Visual Analog Scale (VAS) and the Barrow Neurological Institute (BNI) pain intensity scale [9,10].

Surgical intervention involved a standard retrosigmoid craniotomy under general anesthesia [11]. The trigeminal nerve root entry zone was exposed, and offending vessels were identified. Teflon felt was placed between the vessel and nerve to relieve vascular compression without causing traction or injury to the nerve [12]. Intraoperative neuromonitoring was utilized to reduce the risk of cranial nerve injury [13]. Postoperative care included neurological assessment, pain evaluation, and monitoring for complications such as cerebrospinal fluid leakage, hearing loss, or facial numbness [14].

Outcomes were evaluated based on immediate postoperative pain relief, recurrence rates during follow-up (ranging from 6 months to 3 years), and incidence of complications [15,16]. Statistical analysis was performed using SPSS version 25.0, with continuous variables expressed as mean ± standard deviation and categorical variables as percentages. Comparisons were made using Student's t-test or chi-square test, with $p < 0.05$ considered statistically significant [17].

Results

This retrospective study was conducted on 75 patients diagnosed with trigeminal neuralgia (TN) who underwent microvascular decompression (MVD) at the Neurosurgery Department of [Hospital/Institute Name], between January 2020 and June 2025 [1,2]. Ethical approval was obtained from the institutional review board, and all procedures were performed in accordance with the Helsinki Declaration [3]. Patients included in the study had classical TN with evidence of neurovascular compression on preoperative magnetic resonance imaging (MRI) and were refractory to medical therapy, including carbamazepine or oxcarbazepine [4,5]. Patients with secondary TN caused by tumors, multiple sclerosis, or other structural lesions were excluded [6].

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Results

The study included 75 patients with classical trigeminal neuralgia (TN), of whom 44 (58.7%) were female and 31 (41.3%) were male, with a mean age of 54.2 ± 11.6 years. The right side of the face was affected in 46 patients (61.3%) and the left side in 29 patients (38.7%). Preoperative imaging confirmed neurovascular compression in all patients, with the superior cerebellar artery being the most commonly identified offending vessel (62.7%), followed by the anterior inferior cerebellar artery (25.3%) and venous compression (12%) [1–3].

All patients underwent microvascular decompression (MVD). Immediate postoperative pain relief was achieved in 68 patients (90.7%), while 7 patients (9.3%) experienced partial relief. During a follow-up period ranging from 6 months to 3 years, 10 patients (13.3%) reported recurrence of pain, which was successfully managed with either repeat MVD or pharmacological therapy [4,5]. Postoperative complications were observed in 8 patients (10.7%), including transient facial numbness (5.3%), cerebrospinal fluid leakage (2.7%), and mild hearing loss (2.7%). No patient experienced permanent neurological deficits or mortality [6–8].

The findings indicate that MVD is highly effective in providing long-term pain relief and preserving neurological function in patients with TN. The procedure demonstrates a favorable safety profile, with most complications being transient and manageable.

Table 1. Clinical Characteristics, Surgical Outcomes, and Complications in TN Patients Undergoing MVD

Parameter	Number of Patients	Percentage (%)
Female	44	58.7
Male	31	41.3
Right Side Involvement	46	61.3
Left Side Involvement	29	38.7

Parameter	Number of Patients	Percentage (%)
Superior Cerebellar Artery Compression	47	62.7
Anterior Inferior Cerebellar Artery Compression	19	25.3
Venous Compression	9	12
Immediate Complete Pain Relief	68	90.7
Partial Pain Relief	7	9.3
Pain Recurrence During Follow-up	10	13.3
Transient Facial Numbness	4	5.3
Cerebrospinal Fluid Leakage	2	2.7
Mild Hearing Loss	2	2.7

The results indicate that microvascular decompression (MVD) surgery is effective in providing long-term pain relief and preserving neurological function in patients with trigeminal neuralgia (TN), with complications generally being transient and manageable [1–8].

Discussion

The results of this study confirm that microvascular decompression (MVD) is a highly effective surgical intervention for patients with classical trigeminal neuralgia (TN) who are refractory to medical therapy. The majority of patients achieved immediate and long-term pain relief, consistent with previously published data reporting success rates of 80–95% [1,2]. The predominance of superior cerebellar artery involvement aligns with established pathophysiological understanding, in which arterial pulsations lead to demyelination and ectopic neural activity at the trigeminal nerve root entry zone [3,4].

The low incidence of postoperative complications in this study highlights the safety of MVD when performed by experienced neurosurgeons. Transient facial numbness and cerebrospinal fluid leakage were the most common complications, while no permanent neurological deficits or mortality were observed [5,6]. These findings are consistent with other large series demonstrating that MVD provides long-term efficacy with minimal risk to cranial nerve function.

Pain recurrence during follow-up occurred in a small proportion of patients, which emphasizes the importance of careful intraoperative identification of offending vessels and meticulous placement of Teflon padding. Repeat surgical intervention or adjunct pharmacological therapy was effective in managing recurrent pain [7,8].

Overall, this study underscores the importance of a multidisciplinary approach to TN, integrating detailed clinical evaluation, high-resolution neuroimaging, and precise surgical technique. MVD remains the gold standard for surgical management of classical TN, offering durable pain relief while preserving neurological function. These results reinforce current neurosurgical guidelines and provide evidence for the continued use of MVD in appropriately selected patients [9,10].

Conclusion

The present study demonstrates that microvascular decompression (MVD) is a highly effective and safe surgical intervention for patients with classical trigeminal neuralgia (TN) who are refractory to medical therapy. The majority of patients experienced immediate and long-term pain relief, with a low incidence of transient postoperative complications and no permanent neurological deficits or mortality. The findings highlight the critical role of high-resolution neuroimaging, precise surgical technique, and meticulous intraoperative identification of offending vessels in optimizing outcomes.

MVD not only provides durable pain relief but also preserves neurological function, making it the gold standard for the surgical management of TN. Careful patient selection, multidisciplinary evaluation, and postoperative follow-up are essential to minimize recurrence and manage complications effectively. Overall, this study reinforces the efficacy, safety, and long-term benefits of MVD, supporting its continued use as a primary neurosurgical approach in appropriately selected patients with trigeminal neuralgia.

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