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Original Article

Clinical Profile, Imaging Correlation, and Outcomes of Microvascular Decompression in Classical Trigeminal Neuralgia: A Prospective Observational Study

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ABSTRACT

Background: Trigeminal neuralgia (TN) is an uncommon neuropathic pain disorder characterized by recurrent episodes of severe, electric shock-like facial pain. Although medical therapy is the first-line treatment, many patients require surgical intervention due to inadequate pain control or medication intolerance. This study aims to analyze the demographic characteristics, clinical features, imaging findings, treatment strategies, and outcomes in patients with typical TN, with a focus on microvascular decompression (MVD) as a definitive surgical option.

Methods: A prospective observational study was done on 20 patients with classical TN diagnosed over 2 years. Pharmacotherapy was given to all patients first. Those with poor symptom control or a desire for surgery were subjected to MVD. Information regarding pain distribution, MRI findings, surgical findings, complications, and outcomes of pain relief was gathered and analyzed.

Results: The average age of the patients was 54.65 years, with a female dominance (55%). Right-sided predominance was seen in 60%, and the V2-V3 dermatomes were the most commonly involved (45%). Neurovascular compression was seen on MRI in 60% of the patients. MVD was done in 12 patients, the most frequent of which was the superior cerebellar artery. In the one-year follow-up, complete relief of pain was experienced by 85% of all the patients and 15% had mild residual pain. No statistically significant difference in pain relief was observed between surgical and conservative groups (p=0.656). Postoperative complications were few.

Conclusion: MVD is a safe and effective therapy for select TN patients with good long-term results. Treatment should be individualized according to clinical profile and patient preference.

Key-words: Trigeminal neuralgia, Microvascular decompression, Neuropathic pain, neurovascular compression, Facial pain, Treatment outcome

INTRODUCTION

Trigeminal Neuralgia (TN), or Fothergill's disease, or "tic douloureux," is a disabling neuropathic disorder characterized by brief, severe, and electric shock-like attacks of facial pain.

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The painful paroxysms are usually limited to the trigeminal nerve distribution, rendering TN one of the most agonizing pain syndromes encountered in clinical practice [1]. The trigeminal nerve, or fifth cranial nerve, has three major branches: the ophthalmic (V1), maxillary (V2), and mandibular (V3) divisions. TN most frequently involves the maxillary (V2) and mandibular (V3) branches, with ophthalmic (V1) involvement being less common [2].

Although TN is most commonly seen in individuals greater than 50 years of age, it has been described in much younger patients, including rare instances as early as age three [3]. The disorder exhibits a greater frequency

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in females than in males [4]. Depending on etiology, TN is divided into two forms: classic (or primary) and secondary (or symptomatic). Classic TN generally arises without sensory or motor deficits and is most commonly due to neurovascular compression, specifically by an anomalous arterial loop [5]. Conversely, secondary TN is caused by structural lesions like tumors, arteriovenous malformations, or demyelinating diseases like multiple sclerosis [6].

Pharmacological treatment with first-line therapy includes the use of sodium-channel blockers like carbamazepine and oxcarbazepine, endorsed by international clinical guidelines [7]. Anticonvulsants are effective in managing pain in most patients, but side effects like dizziness, nausea, sleepiness, and alterations in thinking can restrict their use [8]. Of particular interest is the fact that standard analgesics such as paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) are mostly ineffective in the treatment of TN [9]. Other anticonvulsants such as baclofen, gabapentin, valproic acid, phenytoin, topiramate, and lamotrigine can be used individually or in combination based on the response of the patient [10].

Where medical treatment fails or is not tolerated, surgery becomes an option. Among the myriad of surgical approaches—percutaneous glycerol rhizotomy, balloon compression, radiofrequency thermal rhizotomy, gamma knife radiosurgery, and partial sensory rhizotomy—MVD has demonstrated better long-term results in appropriate candidates [11]. MVD addresses the underlying vascular compression by meticulous arachnoid membrane dissection and division of the offending vessel, most commonly a loop of the superior cerebellar artery, from the trigeminal nerve at or near its entry zone in the brainstem [12].

The primary aim of this observational study is to analyze the clinical presentation, radiological appearance, and medical and surgical management of typical TN cases operated with MVD. Special emphasis will be given to the immediate and late postoperative functional outcomes in evaluating the efficacy and longevity of MVD in treating trigeminal neuralgia.

MATERIALS AND METHODS

Study Design and Setting- The current study was an observational study conducted in the Department of Neurosurgery at SCB Medical College and Hospital, Cuttack, Odisha. The duration of the study was May 2022 to August 2024 and involved 20 classical trigeminal neuralgia cases. All the patients were provided with written informed consent before their enrollment into the study, and the protocol of the study was cleared by the hospital's ethical committee.

Study Population- The population of the study included patients reporting to the Department of Neurosurgery, SCB Medical College and Hospital, Cuttack, who were diagnosed and managed for classical trigeminal neuralgia during the study duration. The inclusion criteria were those patients who had a confirmed diagnosis of classical trigeminal neuralgia and were operated on in the institution between May 2022 and August 2024. Those patients who had undergone any form of surgical treatment for trigeminal neuralgia elsewhere, those patients who did not give consent to participate, and patients with a history of post-herpetic neuralgia, multiple sclerosis, or intracranial space-occupying lesions were excluded from the study.

Evaluation and Clinical Examination- Patients involved in the study went through an elaborate history-taking process and thorough clinical examination. The main aim was to establish the diagnosis of classical trigeminal neuralgia and evaluate the severity of symptoms. A selective neurological examination was conducted to examine the trigeminal nerve function and screen for signs of related deficits or other neurological abnormalities.

Radiological Assessment- All the patients were subjected to an MRI brain scan for the detection of any possible compression of the trigeminal nerve by a blood vessel. Imaging was done for the detection of a vascular loop or any structural anomaly causing the compression of the nerve, the most frequent causative etiology of classical trigeminal neuralgia.

Management with Medicines- All patients were initially given conservative treatment and oral carbamazepine was prescribed as first-line medication. Treatment was initiated with 100 mg twice a day, with titration in increments as necessary to manage pain to a maximum of 1200 mg/day in three divided doses. In patients in whom carbamazepine alone did not sufficiently manage the pain, oral baclofen was added. Baclofen therapy was initiated with 5 mg three times a day, with gradual dose titration to a maximum of 80 mg/day in four divided doses. Patients whose pain was well controlled on medical therapy were maintained on regular follow-up at 3 months, 6 months, 1 year, and then yearly.

Surgical Treatment (Microvascular Decompression)- For patients who did not have satisfactory control of pain on medical therapy, MVD was planned as the next treatment, after obtaining consent from the patient. The operative technique consisted of a retro sigmoid craniotomy, during which the junction between the transverse and sigmoid sinuses was visualized. Following the creation of a durotomy, the trigeminal nerve was gently identified, and compression by a vessel was noted. If arterial or venous compression of the nerve was present, the offending vessel was dissected carefully and separated from the nerve. A Teflon patch was then interposed between the vascular structure and the trigeminal nerve to decompress it. Once the decompression had been done, the dura was closed and the surgical wound was closed. Postoperative follow-up was carried out at 3 months, 6 months, 1 year, and every year thereafter.

Postoperative Follow-Up and Complications- All patients treated with MVD, as well as those conservatively managed, were closely followed up for complications post-recovery. These could include possible complications such as infection, cerebrospinal fluid leak, or postoperative numbness of the face. All complications were quickly managed and addressed following standard clinical guidelines.

Outcome Assessment- The main outcome of the study was the alleviation of pain and the incidence of pain recurrence. Pain was measured on the Visual Analogue Scale (VAS), for which patients gave scores from 0 to 10 for pain. A score of 0 indicates no pain, 1-4 was slight pain, 5-9 was moderate pain, and a score of 10 was severe pain. This scale was applied to both conservatively and surgically treated patients, and the results were compared to assess the efficacy of medical and surgical treatment.

Statistical Analysis- At the end of the study, all data and observations were tabulated and analyzed with the help of suitable statistical tools. The purpose was to determine patterns, associations, and the overall efficacy of the treatments used, giving a thorough assessment of the clinical outcomes of the patients suffering from classical trigeminal neuralgia.

RESULTS

Table 1 shows the baseline characteristics of the patients (n=20). The mean age was 54.65±6.38 years, with a female majority (55%). The right side was affected in 60% of cases. Most patients had symptoms for 1 to 1.5 years.

Table 1: Demographic and Clinical Characteristics (n=20)

Variable	Category	n (%) / Mean±SD
Age (years)	–	54.65 ± 6.38
Sex	Male	9 (45%)
	Female	11 (55%)
Side Affected	Right	12 (60%)
	Left	8 (40%)
Duration of Onset	6 months	3 (15%)
	1 year	5 (25%)
	1.5 years	7 (35%)

Table 2 summarizes treatment modalities and outcomes. Most patients underwent microvascular decompression (60%), while 40% were managed conservatively. The most common offending vessels were SCA alone or in combination (50%). Postoperative deficits were observed in 17%, with one case of CSF leak. At 1-year follow-up, 85% reported complete pain relief.

Table 2: Treatment and Outcomes

Variable	Category	n (%)
Treatment	Conservative	8 (40%)
	MVD	12 (60%)
Compressing Vessels*	SCA	5 (25%)
	SCA & AICA	5 (25%)
	SCA & Petrosal Vein	1 (5%)
	Petrosal Vein	1 (5%)
Postoperative Deficits†	Present	2 (17%)
	Absent	10 (83%)

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Other Complications†	CSF Leak	1 (5%)
Pain After 1 Year	No Pain	17 (85%)
	Mild Pain	3 (15%)

**Reported for all 20 patients (NA: 40% for non-surgical cases). Among 12 MVD patients.*

Table 3 shows the association between treatment type and pain relief at 1 year. Both groups had high rates of pain relief, with 83.3% in the MVD group and 87.5% in the conservative group reporting no pain. Mild pain persisted in a small proportion of each group.

Table 3: Association Between Treatment and Pain Relief

Treatment	No Pain	Mild Pain
MVD (n=12)	10 (83.3%)	2 (16.7%)
Conservative (n=8)	7 (87.5%)	1 (12.5%)

Visualizes the split between conservative management (40%) and microvascular decompression (MVD: 60%), emphasizing the primary intervention used (Fig. 1).

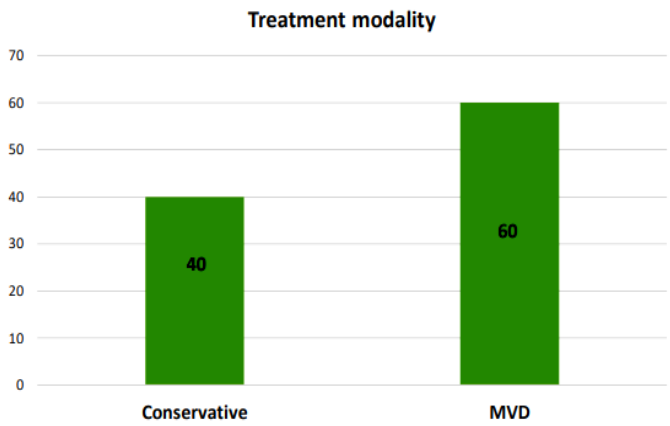

Fig. 1: Treatment Modality Distribution

Highlights outcomes, showing 85% of patients reported no pain post-treatment, critical for assessing efficacy (Fig. 2).

Supports the rationale for MVD by showing vascular compression in 60% of cases, linking pathology to treatment choice (Fig. 3).

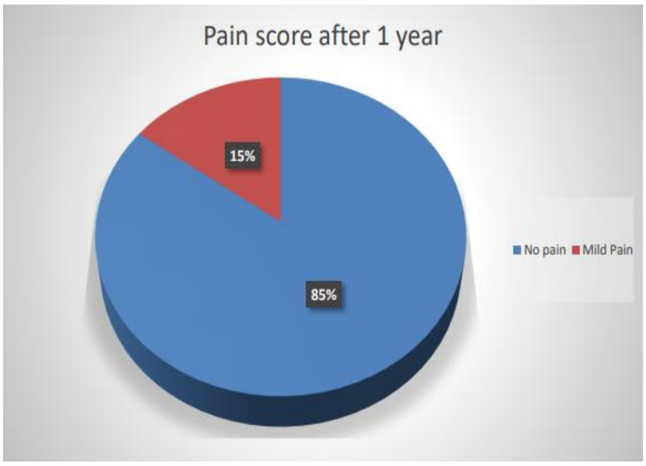

Fig. 2: Pain Relief After 1 Year

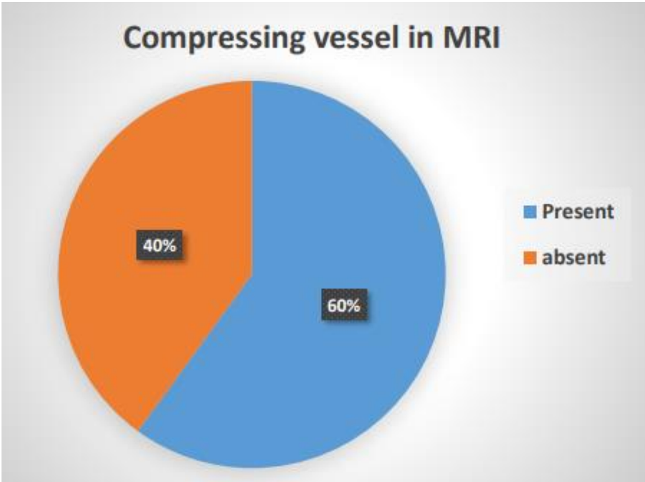

Fig. 3: MRI Neurovascular Compression Findings

Key Findings- A study of 20 classical trigeminal neuralgia patients identified a female (55%) population with a mean age of 54.65 years, with right-sided (60%) facial involvement and pain in the V2V3 dermatomes (45%) being the most frequent. Neurovascular compression identified through MRI in 60% of patients was consistent with the most common (60%) proceeding to MVD, with 40% continuing on conservative treatment. Postoperative results showed excellent relief of pain, with 85% of patients having no pain at one year, although 15% had mild residual pain. Interestingly, complications like transient neurological deficits (17%) and CSF leaks (5%) were uncommon after MVD. Notably, no statistically significant long-term difference in pain outcome between surgical and conservative management occurred (p=0.656), indicating both approaches may be options based on clinical presentation and patient preference.

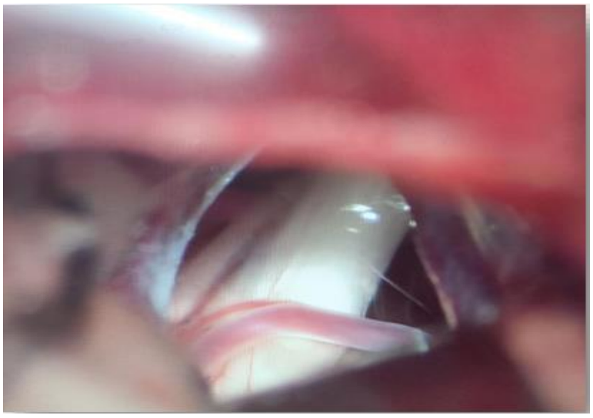

Fig. 4: Intra operative arterial compression

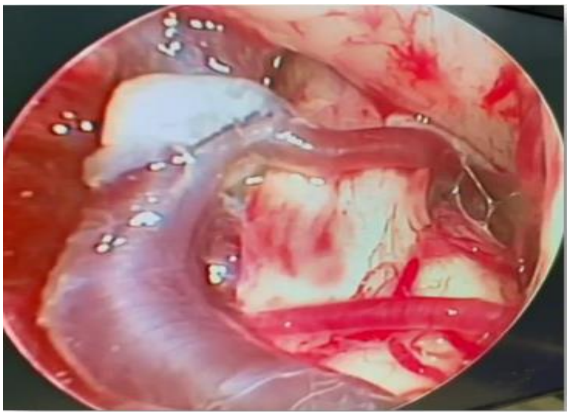

Fig. 5: Intra operative arterial plus venous compression

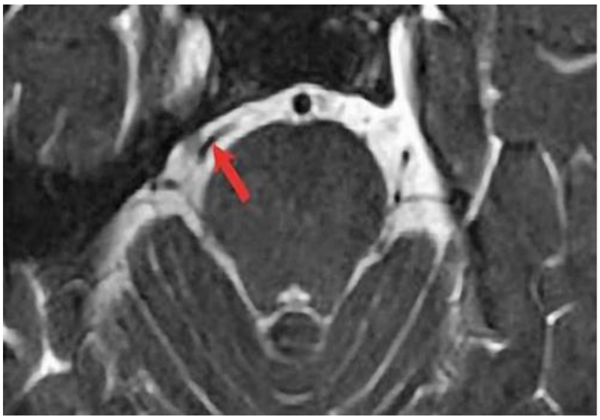

Fig. 6: Vascular compression on MRI

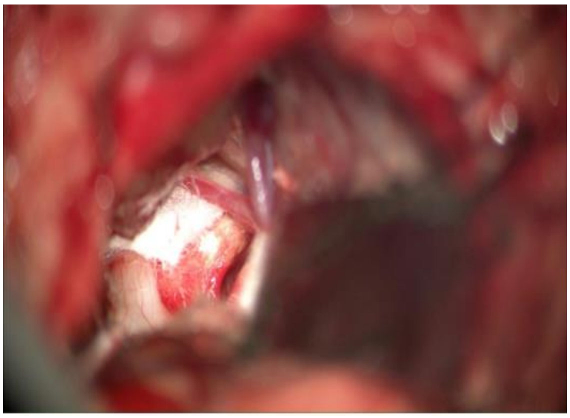

Fig. 7: Teflon patch given between 5th nerve and compressing vessel

DISCUSSION

In this prospective case series of 20 patients with classical TN, there were several significant clinical, radiological, and treatment-related findings. The mean age of the patients was 54.65 years, and female predominance (female-to-male ratio was 1.22) was noted, which is as per previous literature showing a higher prevalence of TN in middle-aged females. Right-sided facial weakness was more common than left and had a ratio of 1.5:1, with the V2V3 being the most frequent dermatome combination affected, reproducing previous literature results reporting predominance of involvement of V2 and V3 branches and absence of isolated V1 involvement [14,15]. The type of pain elicited by the patients-lancinating, electric shock-like, and sharp-is in accord with the traditional characteristics of TN and is congruent with its clinical diagnosis, provided there has been no previous trauma or dental intervention.

MRI with high-resolution sequences like CISS and FIESTA was carried out to identify neurovascular compression (NVC), which is an established etiological feature of classical TN. Compression was found in 60% of patients in this study, which is less than the 96–97% reported in other studies [13,16]. This may be due to the small number of patients, reduced statistical power, or possibly variations in imaging resolution or interpretation.

Conservative management with antiepileptic drugs (AEDs), specifically sodium channel blockers, was given to all patients first. Surgery, MVD, was available to those not responding to medical therapy or patient preference. MVD was done in 12 patients, whereas 8 received conservative treatment. The reason to select MVD in these individuals was justified because neurovascular compression was observed on MRI. During the operation, the superior cerebellar artery (SCA) was found to be the most common offending artery, either in isolation or in association with the anterior inferior cerebellar artery (AICA) or petrosal vein. This is consistent with earlier published anatomical series where SCA is most frequently implicated in neurovascular conflict, usually with accompanying venous elements like petrosal vein [17-19].

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Surgical outcomes were favorable, with 85% of all patients reporting no pain after one year, including 83.3% in the MVD group. Mild residual pain was reported by 16.7% of surgically treated and 12.5% of conservatively treated patients, with no statistically significant difference between the groups (p=0.656). This absence of significant association contrasts with previous findings by Zakrzewska *et al.* who found superior long-term outcomes with surgical management over medical therapy [20]. The difference in results might be explained by the limited sample size and comparatively short duration of follow-up in the current study.

Complications after MVD were uncommon but significant. Postoperative neurological deficits occurred in two patients (17%)—one had lower motor neuron type facial palsy and one had trigeminal sensory loss. One patient (5%) also had a cerebrospinal fluid (CSF) leak. These complication rates are marginally higher than those experienced by McLaughlin et al., where cranial nerve deficits and CSF leaks were rare [17]. Once again, the small number of patients may be a factor for the comparatively high complication rates reported.

In summary, the current study emphasizes that although both surgical and conservative treatments are useful in the management of classical TN, individualized treatment decisions should be made based on imaging results, patient preference, and tolerance to initial therapy. The utility of MRI in diagnosing NVC continues to be vital for planning surgical intervention, and MVD remains to provide excellent long-term pain relief at an acceptable risk profile. Nonetheless, further larger and longer follow-up studies are required to validate such results and define the relative treatment effectiveness more specifically.

CONCLUSIONS

In conclusion, trigeminal neuralgia is a rare but severely disabling disorder with intense facial pain that has a significant quality-of-life impairment in patients. While pharmacotherapy is still the first-line treatment and is successful in most, a significant number of patients need surgery due to insufficient pain control or side effects of medication. Here in this research, MVD also showed good results with few complications, which reiterated its position as a safe, effective treatment to be used with carefully selected patients. Due to the chronic presentation of the disorder and the chances of recurrence or treatment resistance, a patient-driven, multidisciplinary strategy has to be there in individualizing the therapy. All patients must be made aware of surgical options, especially MVD, to facilitate shared decision-making that weighs risks, benefits, and long-term quality-of-life outcomes.

CONTRIBUTION OF AUTHORS

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Data analysis and Interpretation- Rabinarayan Panda
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Critical review- Sanjib Mishra, M. K Dhir
Article editing- Rabinarayan Panda, Sourabh Das
Final approval- Sanjib Mishra, M. K Dhir

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