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Research Article

# Pure V1 Trigeminal Neuralgia Caused by Vascular Compression

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## Abstract

**Background:** Only 2%-5% of all patients with trigeminal neuralgia (TN) have localized disease to the first branch (V1). In this report, we describe the management of five cases of pure V1 territory TN.

**Methods:** The series included three men and two women with a mean age of 63 years. The affected side was the right side in four cases and the left side in one case. All cases presented with typical TN manifestations. Preoperative three-dimensional magnetic resonance cisternogram/angiogram fusion images were obtained to evaluate the anatomical relationship between the trigeminal nerve and the responsible vessel. Microvascular decompression (MVD) was performed using the retrosigmoid approach.

**Results:** The postoperative course was excellent in all patients. No obvious postoperative complications were observed. The surgical findings were consistent with the preoperative imaging findings. Vessel compression was identified primarily from the supero-medial side of the nerve, and the most compressed site tended to be on the caudal side on the supero-medial plane in four cases.

**Conclusions:** The direction of compression on the nerve of the pure V1 TN was assessed. MVD is an effective treatment for pure V1 TN.

**Keywords:** Magnetic Resonance Imaging; Trigeminal Neuralgia; V1 Territory; Vascular Compression

## Abbreviations

BNI: Barrow Neurological Institute; TN: Trigeminal Neuralgia; MRA: Magnetic Resonance Angiogram, MRC: Magnetic Resonance Cisternogram; MVD: Microvascular Decompression; V1: The First Branch of Trigeminal Nerve; V2: The Second of Trigeminal Nerve; V3: The Third Branch of Trigeminal Nerve

## Introduction

Although trigeminal neuralgia (TN) can occur predominantly in the area of the second (V2) and third (V3) branches, symptoms isolated to V1 (pure V1 TN) are rare, accounting for approximately 2.2%-5.6% of cases [1,2]. The primary causes of pure V1 TN are postherpetic trigeminal neuralgia [3] and short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing (SUNCT) [4]. The first step in treating TN is medical therapy. When the efficacy declines, radiotherapy [5], nerve blocks [6], and microvascular decompression (MVD) [2,7] are considered. MVD is the fundamental treatment, with suitable outcomes and a low complication rate [2,7]. Here, we describe five cases of pure V1 TN, including their anatomical characteristics, based on our surgical findings and the usefulness of MVD.

## Methods and Materials

MVD for TN was performed by the author in 124 cases from April 1, 2018, to March 31, 2022. Of these cases, five (4.0%) ex-

perienced pain only in the V1 territory of the trigeminal nerve (Table 1), paroxysmal electric shock pain, triggered by contact, eating. The pain level was evaluated using the Barrow Neurological Institute pain intensity (BNI) scale [8] pre- and postoperatively. Threedimensional magnetic resonance cisternogram/angiogram (3D-MRC/MRA) fusion images were obtained to observe the anatomical architecture around the trigeminal nerve and the responsible vessels preoperatively.

| Patient | Age and sex | Past history | Laterality | Trigger | Preoperative BNI scale | Symptom duration (years) | Preoperative imaging offending vessel | Preoperative imaging compression direction |
|---|---|---|---|---|---|---|---|---|
| 1 | 67F | HT, DM | R | + | 4 | 8 | SCA | Superomedial |
| 2 | 63M | HT, HL | L | + | 5 | 12 | SCA | Superomedial |
| 3 | 62M | HT | R | + | 4 | 18 | SCA | Superomedial |
| 4 | 55F | | R | + | 5 | 9 | SCA | Superomedial |
| 5 | 66M | HT | R | + | 4 | 10 | SCA | Superomedial |

**Table 1:** Operative details.

HT: Hypertension; HL: Hyperlipidemia; DM: Diabetes Mellitus; BNI: Barrow Neurological Institute Pain Intensity; SCA: Superior Cerebellar Artery; R: Right; L: Left

MVD was performed under general anesthesia in the lateral recumbent position with continuous auditory brainstem response monitoring. A liner skin incision was made in the retroauricular region and a small craniotomy was performed. The horizontal fissure was opened to access the trigeminal nerve, and trigeminal nerve compression by the responsible vessel was identified. For decompression of the trigeminal nerve, the transposition, i.e., a manipulation to move the responsible blood vessel, was applied. The direction of compression by the responsible vessel to the trigeminal nerve was evaluated according to the criteria of the compression patterns for trigeminal nerves by

Sindou., *et al*. [2]. All procedures used in this research were approved by the Ethical Committee of International University of Health and Welfare.

## Results

Three males and two females were included. Age was 55-67 (mean, 63) years. The affected side was right in four cases and left in one case. The time from onset to surgery ranged from 8 to 18 (mean, 11.4) years. All patients presented with typical TN manifestations, including paroxysmal electric shock pain, triggered by contact and eating. No autonomic symptoms, such as lacrimation, were observed. Four patients had hypertension, hyperlipidemia, or diabetes mellitus. No family history of TN was noted.

Preoperative 3D-MRC/MRA fusion images showed that the responsible vessel in all cases was the superior cerebellar artery (SCA), and the trigeminal nerve was compressed from the supero-medial side (Figure 1A, B). In addition, the most intense compression site was expected to be at the caudal side of the supero-medial plane of the trigeminal nerve in four cases (Figure 1A, B). The most compressed site in one case was expected to be at the cranial side of the supero-medial plane.

Surgical findings were consistent with the preoperative images. The trigeminal nerve was severely compressed from the supero-medial side by the SCA (Table 2). In four cases, the most compression was confirmed to be on the caudal side of the supero-medial plane. (Figure 1C). The most compressed site in one case was the cranial side of the supero-medial plane. The nerves were deformed by the compression of the responsible vessel in all cases. There were no obvious adhesions around the trigeminal nerve. Intraoperative bleeding was minimal, and the average operative time was 1h and 30 min. All patients underwent transposition for decom-

| Patient | Surgical time (min) | Detailed compression site (surgical findings) | Postoperative BNI | Complications |
|---|---|---|---|---|
| 1 | 80 | Caudal side on superomedial plane | 1 | - |
| 2 | 100 | Caudal side on superomedial plane | 1 | - |
| 3 | 90 | Caudal side on superomedial plane | 1 | - |
| 4 | 100 | Cranial side on supero-medial | 1 | - |
| 5 | 80 | Caudal side on superomedial plane | 1 | - |

**Table 2:** Operative details.

BNI: Barrow Neurological Institute Pain Intensity

pression of the trigeminal nerve, and sufficient nerve decompression was achieved. No obvious postoperative complications were noted. TN resolved immediately after surgery in all cases. Preoperative BNI score was grade IV in three cases and grade V in two, but all patients achieved grade I postoperatively. The average postoperative hospital stay was 8 days.

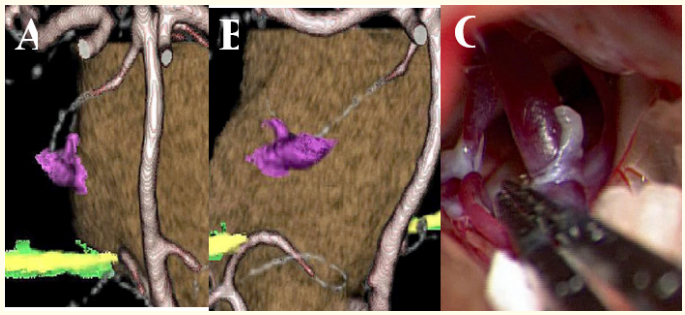


**Figure 1:** Case 1 was a 67-year-old woman who had been experiencing paroxysmal electric pain in the right first branch area of trigeminal nerve triggered by washing her face for 8 years. The patient underwent surgery due to decreasing effectiveness of medication. Her medical history included hypertension and diabetes. Preoperative three-dimensional magnetic resonance cisternogram/angiogram (3D-MRC/MRA) fusion image (A and B) showed rt. trigeminal nerve (purple) compressed supero-medially by the superior cerebellar artery (SCA, arrowhead). It was suspected that the pressure was particularly severe on the caudal side of the nerve (arrow). Surgical findings (C) showed that rt. trigeminal nerve was compressed supero-medially by SCA, particularly at the caudal side on the nerve (arrow).

## Discussion

Several disorders can cause severe pain limited to the V1 territory of the trigeminal nerve. Postherpetic TN, which has a preferred territory in the V1 of the trigeminal nerve [3], may also be associated with sensory disturbance, which can result in corneal ulceration and blindness [3]. Clinical history and neuroimaging may be used to diagnose postherpetic TN. In our cases, there was no eruption on the face and there were no findings to suggest the infection of herpes zoster. SUNCT is a primary headache characterized by unilateral periorbital pain with autonomic symptoms [4]. In our cases, SUNCT was ruled out because there were no autonomic symptoms, the pain triggers were clearly confirmed, and neuroimaging showed the compression of the trigeminal nerve by the responsible vessel.

Pennisi., *et al.* [9] counted the myelinated fibers of the trigeminal nerve by dividing them into V1, V2, and V3. The ratio of the number of fibers in V1, V2, and V3 is 1:2:3, which may explain the low frequency of TN involving the V1. However, the percentage of V1 fibers in the trigeminal nerve root is ~17%, which does not explain the small number of V1 alone cases (2%-5%). Anatomical compression patterns may play an important role [1,2]. Sin-

dou., *et al.* examined 538 cases that presented with typical TN to determine the direction of vascular compression of the trigeminal nerve [2]. They found that all cases presenting with pure V1 TN showed compression on the supero-medial side of the trigeminal nerve. Symptoms in V2 are often caused by compression from the supero-medial side or supero-lateral side and symptoms in the V3 are often caused by compression from the inferior side.

All of our cases also showed compression from the supero-medial side, which is consistent with the report [2]. In addition, a more detailed analysis revealed that in four of our cases (80%), the compression plane was from the supero-medial side and the compression site was at the caudal side on the plane. Sites of V1, V2, and V3 are arranged from the medial to lateral side of nerves [10]. However, the vascular compression sites may not exclusively predict the development of neurologic symptoms [2]. Multiple factors influence the somatotopy of TN, such as nerve distortion, inflammation, atrophy, nerve angulation at the petrous ridge, and different pain thresholds among branches [2].

Gamma knife surgery (GKS) is one of the primary treatments for TN. Régis., *et al*. reported that 90% of patients responded immediately after treatment, but the response rate declined to 70% after 3 years and 45% after 10 years [5]. An additional problem is that 20% of patients have residual permanent facial numbness [5]. A recent report by Wang., *et al.* showed efficacy as a treatment for V1 alone TN using radiofrequency thermocoagulation [6]. They have shown additional usefulness by modifying the method of puncture for supraorbital foramen from the conventional vertical to the transverse direction. A positive effect was seen in 93% of the patients immediately after the procedure, which decreased to 64% after 2 years; further, in most cases, facial numbness remained for a long period although the degree of numbness varied [6]. In MVD, 80% of cases continue to have symptom resolution even after long-term follow-up, and the complication rate is ~5% [7]. Compared with GKS and radiofrequency thermocoagulation, MVD is considered more invasive, but as per reported cases, it is not highly invasive because of its short operative time, minimal intraoperative bleeding, and availability of MVD in elderly patients with few complications [7]. MVD is an effective treatment with a cure rate of over 90% and a relatively low complication rate [7].

3D-MRC/MRA fusion images can accurately identify the responsible vessel in TN cases and can also identify nerve deformities. We have reported that 3D-MRC/MRA fusion images were useful in preoperative evaluation in surgical decision making and simulation [11]. In the present cases, we could obtain a detailed understanding of the vascular compression status, which was useful as preoperative information. Given the limitations of the surgical field, 3D-MRC/MRA imaging may capture the site of vascular compression of the responsible nerve, allowing for accurate preoperative simulation [12]. Further efforts are needed to improve the clarity of neuroimaging and to obtain more high-quality images.

## Conclusion

The site of vascular compression in pure V1 trigeminal neuralgia was suggested to be on the caudal side of the supero-medial plane of trigeminal nerve. MVD is a fundamental and effective and should be aggressively considered.

## Competing Interests

The authors declare that they have no conflict of interest.

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## Ethics Approval

All procedures used in this research were approved by the Ethical Committee of International University of Health and Welfare.

## Submission Statement

This manuscript is original and has not been submitted elsewhere in part or in whole.

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