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Peripheral Nerve

Surgical Outcomes Following Distal Nerve Decompression in Patients With Trigeminal Neuralgia

Merel H.J. Hazewinkel, MD*
Leonard Knoedler, MD†
Katya Remy, MD†
Sierra Tseng, BA†
William G. Austen Jr, MD†
Lisa Gfrerer, MD, PhD*

Background: Patients with headache disorders may present with compression of distal trigeminal nerve branches as well as other head and neck nerve branches such as the occipital nerves. In addition, a coexisting diagnosis of trigeminal neuralgia of proximal origin may be present. This overlap in diagnoses complicates treatment. Therefore, this study aimed to investigate the therapeutic effects of distal nerve decompression surgery in patients with coexisting trigeminal neuralgia from a proximal origin.

Methods: The charts of 1112 patients who underwent screening for nerve decompression surgery were retrospectively reviewed. Patients with trigeminal neuralgia who underwent nerve decompression surgery were included. Data regarding preoperative and postoperative pain characteristics were collected.

Results: Seventeen (1.5%) patients met the inclusion criteria and underwent nerve decompression. Fifteen patients (56%) underwent occipital decompression (13 greater occipital nerve decompressions, and 10 lesser occipital nerve decompressions), 5 patients (19%) underwent frontal decompression (supraorbital nerve/supratrochlear nerve decompression), and 6 patients (22%) underwent temporal decompression (4 zygomaticotemporal decompressions and 2 auriculotemporal nerve decompressions). Among the patients who underwent occipital decompression, 11 (73%) patients reported ≥80% pain relief, 1 (6.7%) patient reported ≥50% pain relief, and 3 (20%) patients reported ≤20% pain relief. For frontal and/or temporal decompression, only 2 (28%) patients achieved substantial pain relief (100% and 50%), whereas 5 (71%) patients experienced ≤20% pain relief.

Conclusions: Our results demonstrate that occipital nerve decompression is an effective treatment for alleviating occipital neuralgia in individuals with coexisting proximal trigeminal neuralgia. However, the outcomes of frontal and temporal decompression were less favorable. *(Plast Reconstr Surg Glob Open 2025; 13:e6507; doi: 10.1097/GOX.0000000000006507; Published online 10 February 2025.)*

INTRODUCTION

For patients with refractory headache disorders (HDs) that stem from nerve compression, peripheral nerve decompression surgery has been shown to be an effective therapy.[1] The most common nerves treated with nerve decompression are the greater occipital nerve (GON), the lesser occipital nerve (LON), and the third occipital nerve that arise directly from the cervical nerve roots.[2,3] In addition, neurolysis of the distal trigeminal nerve branches including the supraorbital (SON), supratrochlear (STN), zygomaticotemporal, and/or auriculotemporal nerve (ATN) is frequently performed.[4,5] Careful selection of surgical candidates is essential to optimize outcomes.[6,7] Current screening algorithms include clinical history and physical examination, imaging, Doppler ultrasound, diagnostic nerve blocks, and pain drawings.[8,9] Patient pain drawings are especially helpful to identify and differentiate neuralgias of the head and face that are amenable to nerve decompression. Pain sketches classified as atypical have been shown to predict poor surgical outcomes.[10] These atypical drawings include pain of the cheeks and jaw, a common feature of patients with trigeminal neuralgia (TN) (Fig. 1).[11,12] Although nerve decompression addresses individual terminal branches of

*From *Division of Plastic and Reconstructive Surgery, Weill Cornell Medicine, New York, NY; and †Division of Plastic and Reconstructive Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, MA.*

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the trigeminal nerve, classic TN symptoms are broad and typically involve multiple branches. Therefore, the pathology is likely located more proximal and cannot be resolved with decompression of distal branches. It is important to differentiate between patients who experience symptoms of distal trigeminal nerve branch compression versus proximal irritation. Distal branch compression can be identified in patients presenting with a focal starting point of the pain and a distinct radiation pattern, whereas classic TN involves pain in the entire innervation zone of several divisions of the trigeminal nerve, as described by the International Classification of Headache Disorders third edition.[13]

In addition, patients with TN may present with compression of other head and neck nerve branches. For example, occipital neuralgia (ON) may coexist with neuralgia of the distal trigeminal nerve branches or proximal trigeminal nerve branches which further complicates diagnosis and treatment. Given this overlap of neuralgias between proximal and distal trigeminal nerve branches as well as other head and neck nerves, it is important to understand whether a concomitant diagnosis of classic TN influences surgical outcomes following decompression of terminal trigeminal nerve branches and other head and neck nerves. Currently, there is no literature that evaluates the impact of TN on surgical outcomes following peripheral nerve decompression. In this study, we aimed to investigate the therapeutic effects of peripheral nerve decompression in a cohort of patients who presented with TN and coexisting neuralgias.

METHODS

Institutional review board approval was obtained at the 2 participating centers. The charts of 1112 patients with HD who underwent screening for nerve decompression surgery between September 2012 and October 2023 were retrospectively reviewed. Adult patients with a neurologist-confirmed diagnosis of classic TN, as defined by the International Classification of Headache Disorders third edition criteria, who underwent nerve decompression surgery were included.[14] We excluded patients who were younger than 18 years of age. Verbal informed consent of all patients was obtained.

Screening for nerve decompression surgery was performed by the 2 senior authors, which included (1) confirmation of failed conservative management, (2) history and examination findings consistent with nerve compression headache, (3) pain drawings suggestive of nerve-related pain, and (4) pain relief following nerve blocks. The 2 senior authors performed all surgical procedures. Data regarding demographic information, medication use and pain frequency (pain days per month), intensity (scale of 0–10), and duration (in hours) were prospectively collected preoperatively, at 3 months and 12 months postoperatively, and yearly for up to 5 years thereafter. Data were stored in REDCap, a browser-based electronic data collection platform (version 8.1.20; Vanderbilt University, Nashville, TN).[15]

The primary outcomes included patient-reported pain improvement as well as postoperative changes in pain frequency (days/month), duration (hours/day), intensity (scale 0–10 on the visual analog scale). Surgical success was defined as ≥50% patient-reported pain improvement.

Takeaways

Question: Does peripheral nerve decompression surgery effectively treat pain in patients with both trigeminal neuralgia and coexisting peripheral neuralgias?

Findings: This retrospective study of 17 patients with trigeminal neuralgia who underwent peripheral nerve decompression showed that 80% of patients who had occipital decompression reported ≥50% occipital pain relief. However, 71% of patients who underwent frontal or temporal decompression experienced ≤20% pain relief at the operative site.

Meaning: Occipital nerve decompression can effectively treat occipital pain in trigeminal neuralgia patients with coexisting neuralgias, but frontal and temporal decompressions are less successful.

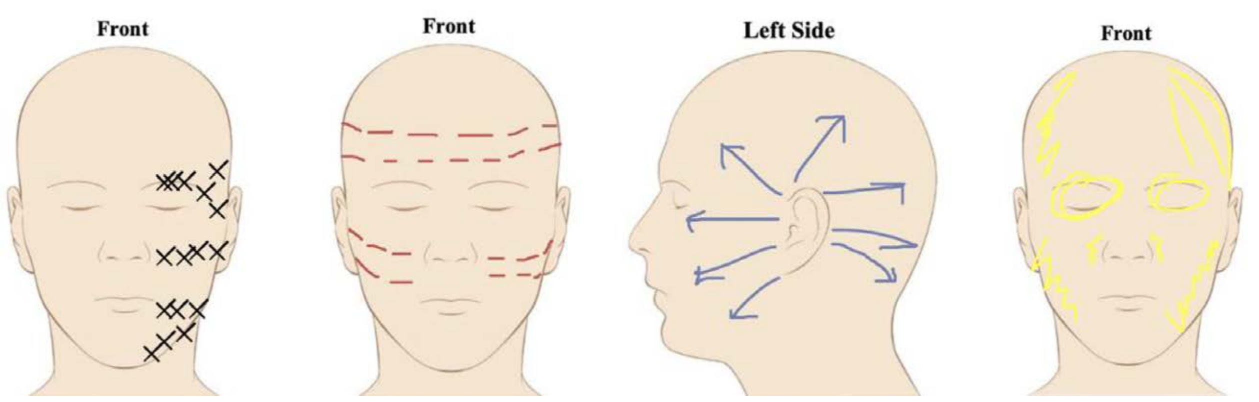

Fig. 1. Examples of atypical pain drawings. Atypical pain drawings depict pain all across the head and neck in nonanatomical locations and radiation patterns. There is no clear point of onset and no clear radiation pattern. Pain drawings depicting pain in the cheeks and jaw are considered atypical as well.

Table 1. Demographics

	All Patients (n = 17)
Variable	n (%)
Age, median (IQR), y	51 (35–58)
Female sex, n (%)	15 (88)
Race, n (%)	
White	15 (88)
Other	2 (12)
Working status, n (%)	
Employed	11 (64)
Disabled	3 (18)
Retired	3 (18)
History of head or neck injury, n (%)	6 (36)
Secondary diagnoses, n (%)	
Occipital neuralgia	15 (88)
Chronic migraine	11 (64)
Posttraumatic headache	2 (12)
Chronic daily headache	1 (5.9)

IQR, interquartile range.

Data Analysis

Data were analyzed with RStudio (2020) (Integrated Development for R. RStudio, PBC, Boston, MA).[16] Categorical variables were described using frequencies and percentages. The Shapiro–Wilk test was used to assess the normality of continuous variables. Continuous variables with normal distribution were described using means and SDs, whereas continuous variables with a nonnormal distribution were described using medians and interquartile ranges. Continuous variables were compared using the Wilcoxon signed-rank test. To compare the surgical success rate (defined as ≥50% pain relief) between the occipital and frontal/temporal decompression groups, the Fisher exact test was conducted. A *P* value of less than 0.05 was considered significant.

RESULTS

Demographics

Seventeen (1.5%) patients had a diagnosis of TN and met the inclusion criteria. Table 1 summarizes the demographic data. The majority of the patients were women (88%), and the median age at the time of surgery was 51 (35–58) years. All patients (100%) were diagnosed with at least 1 concomitant HD including ON (n = 15, 88%), chronic migraine (n = 11, 64%), posttraumatic headache (n = 2, 12%), and chronic daily headache (n = 1, 5.9%).

Preoperatively, the median number of pain days was 30 (28–30) days/month, the median pain duration was 24 (24–24) hours, and the median pain intensity was 8 (8–10). Every patient (100%) trialed at least 3 different pharmacologic classes of medications. All patients underwent nerve block injections (100%), and 14 (82%) patients underwent injection with botulinum toxin. Furthermore, additional treatments included microvascular decompression (MVD) (n = 3, 18%), septal surgery (n = 3, 18%), radiofrequency ablation (n = 2, 12%), dentist guard (n = 2, 12%), and spinal cord stimulation (n = 1, 5.9%).

Surgery

Patients underwent occipital decompression (n = 15, 56%; 13 GON decompressions, and 10 LON decompressions), frontal decompression (n = 5, 19%; SON/STN decompression), and temporal decompression (n = 6, 22%; 4 zygomaticotemporal decompressions, and 2 ATN decompressions). The average time of postoperative follow-up was 17 (±12) months.

Surgical Outcomes: Occipital Decompression

Among the patients who underwent occipital decompression (n = 15), 4 (27%) patients experienced complete pain resolution, 7 (47%) patients reported ≥80% pain relief, 1 (6.7%) patient reported ≥50% improvement in pain, 1 (6.7%) patient reported ≥20% pain relief, and 2 (13%) patients reported ≤20%. Postoperative pain characteristics are reported in Table 2. The median number of pain days per month significantly decreased by 6 days (0–24) (*P* = 0.009), the median pain intensity significantly decreased by 4 (2–7) (*P* = 0.002), and the median pain duration in hours significantly reduced by 16 (0–22) hours (*P* = 0.010). There was 1 patient who underwent occipital nerve decompression who reported 30% improvement of TN symptoms located in the jaw and cheek.

Surgical Outcomes: Frontal and Temporal Decompression

For frontal and/or temporal decompression (n = 7), there were 2 (28%) patients who achieved substantial pain relief (100% and ≥50%), whereas 5 (71%) patients experienced ≤20% pain relief. There was no significant difference in reduction of pain characteristics (Table 2).

When comparing surgical success between both groups, patients who underwent frontal and/or temporal decompression surgery were less likely to achieve at least a 50% pain improvement as compared with patients who underwent occipital decompression surgery (80% versus 29%, *P* = 0.05).

DISCUSSION

Decompression of head and neck nerves has been found to be a successful treatment for neuralgias that

Table 2. Postoperative Pain Characteristics

Variable	Occipital (n = 15)	*P*	Frontal/Temporal (n = 7)	*P*
Pain characteristics, median (IQR)				
Decrease of pain frequency, d/mo	6 (0–24)	**0.009***	0 (0–3)	0.181*
Decrease of pain duration, h	16 (0–22)	**0.010***	0 (0–9)	0.371*
Decrease of pain intensity, 0–10	4 (2–7)	**0.002***	0 (0–1.5)	0.181*

Boldface values indicate statistical significance.
*Wilcoxon signed-rank test.
IQR, interquartile range.

stem from distal compression of nerve branches. The main nerves that have been treated include nerves from the cervical root such as the greater and LONs and terminal trigeminal nerve branches such as the SON/STN. However, the classically described proximal TN is broader and involves more than 1 trigeminal nerve branch, therefore indicating a more proximal pathology. Classic TN sometimes occurs concurrently with other neuralgias such as ON. Pain caused by ON starts near the occiput and often radiates to the front of the head, where it can overlap with TN symptoms. This coexistence of neuralgias raises the question whether a simultaneous diagnosis of TN can affect the success of peripheral nerve decompression surgery. This study investigated the postoperative outcomes of peripheral nerve decompression in patients who presented with TN.

We found that the majority of patients (80%) with TN who underwent occipital decompression reported good postoperative results (≥50% pain relief). In contrast, among the patients who underwent surgery at the frontal or temporal sites, 71% experienced minimal relief (≤20%). These poor surgical outcomes may be due to a more proximal location of compression within the trigeminal nerves rather than at terminal branches. Consequently, decompression of terminal nerve branches does not result in pain improvement.

Among the 15 patients who underwent occipital nerve decompression surgery, 13 patients experienced alleviation of their pain symptoms after surgery. Two patients reported no improvement of pain. The first patient presented with right occipital pain. She previously underwent left MVD of the trigeminal nerve without improvement. She also underwent placement of a motor cortex stimulator in the occipital area and radiofrequency ablation (RFA) of the GON. In previous literature, it has been shown that patients who have been treated with RFA have a higher rate of macroscopic nerve damage compared with patients who have not been treated with RFA and may have worse outcomes. In addition, RFA-treated patients have an increased risk of requiring reoperation at the site of primary decompression due to refractory symptoms.[17] Furthermore, a stimulator was placed 12 years before the patients underwent nerve decompression surgery. Although the hardware was removed during occipital decompression surgery, there is a possibility that this patient could have been experiencing persistent nociceptive pain due to irreversible damage to the nerve. The patient did not undergo further surgery, although previous research has shown that patients who undergo neurectomy after RFA have similar outcomes to patients who undergo primary decompression.[17] At her last follow-up, she reported right occipital pain.

The second patient presented with pain in the left occipital area and had a history of ventriculoperitoneal shunt placement to treat hydrocephalus and ethmoidectomy with septoplasty for rhinogenic pain related to chronic ethmoid sinus disease. Additionally, this patient underwent RFA treatments of the GON. After occipital nerve decompression surgery, she experienced no relief. Her occipital pain is likely multifactorial and up to date, and the etiology of her pain is still unclear despite extensive evaluation and without sustained response to multiple medications and procedures.

Interestingly, 1 patient reported relief of TN symptoms located in the cheek and the jaw after occipital decompression surgery. This can be explained as referred pain caused by the trigeminocervical complex (TCC). The TCC refers to a group of neurons located in the C2 dorsal horn of the spinal cord. These neurons receive input from the trigeminal nerve and cervical structures innervated by the cervical C1–3 roots. Within the TCC, the trigeminal and cervical sensory input converge.[18] The GON, which is often affected in patients with ON, arises from C2 and C3.[19] When the GON experiences compression, it can lead to increased sensitivity in the TCC. This sensitivity can cause the nervous system to misinterpret signals and, as a result, lead to facial pain. Subsequently, it is possible that facial pain resolves when the GON is decompressed.[20–22] However, our prior work has shown that typically, facial pain does not resolve after occipital nerve decompression.[10]

Among the 7 patients who underwent frontal and/or temporal decompression, the majority of the patients (71%) experienced ≤20% relief of their pain symptoms after surgery. It is possible that the wrong diagnosis was made and that the compression was located more proximal and not at the terminal trigeminal nerve branches. Often, TN arises from neurovascular compression at the proximal branches of the trigeminal nerve, known as the root entry zone. Due to the proximal location of the compression, the pain cannot be treated with distal decompression.[23]

Accurate preoperative diagnosis can be challenging. The authors recommend using evidence-based diagnostic tools, including pain drawings, nerve blocks, and Doppler when evaluating patients with TN for possible frontal or temporal decompression. It has been shown that patients with typical pain sketches, showing a focal starting point and a clear radiation pattern, have good postoperative results. Patients with TN often draw a broad, facial pain pattern with pain in the jaw and the cheek, which is categorized as an atypical pain drawing (Fig. 1). These atypical pain drawings are associated with poor surgical results.[10] Asking patients to draw their pain could help a surgeon to identify surgical candidates. Furthermore, nerve blocks play a crucial role in pinpointing the pain's origin. A previous study reported that a positive response to a nerve block, which is defined as ≥50 reduction of pain intensity following the administration of anesthetic injection, is an indicator for successful surgery.[24] Additionally, patients who report pain relief lasting ≥24 hours have reported enhanced postoperative outcomes.[25] Finally, a positive Doppler signal can serve as confirmation for distal nerve compression caused by a vessel, such as the compression of the ATN by the superficial temporal artery.[26]

In addition, we recommend a magnetic resonance imaging brain to evaluate the trigeminal nerve to examine the proximal trigeminal nerve and root.[27] If imaging reveals a neurovascular contact of the trigeminal nerve root, indicating classic TN, other treatments may be indicated and referral to neurosurgery is warranted.

Treatment of classic TN starts with medication, including carbamazepine or oxcarbazepine as first-line treatments. If pharmacotherapy is insufficient for pain control or has intolerable side effects, surgery can be considered. For classical TN with evidence of vascular compression on MRI, MVD is typically the first surgical option. MVD provides pain relief in 68%–88% of patients at 1–2 years postoperatively, and 63%–86% are free of pain at 5 years.[28,29] Complications of MVD can include aseptic meningitis; ipsilateral hearing loss; diplopia; facial palsy; facial numbness; cerebrospinal fluid leak; brainstem infarct; and rarely, death (0.3%).[30] Other surgical options include percutaneous procedures such as rhizotomy, thermocoagulation, and balloon compression or gamma knife radiosurgery, with success rates ranging from 19% to 82%.[31,32]

It is important to interpret the findings of this study in the light of its limitations. First, a manual chart review was performed to collect data regarding the confirmation of the TN diagnosis; therefore, our analysis was dependent on the accuracy of the data recorded. Second, the sample size of patients within our cohort is relatively small, which may limit the generalizability of the reported results. Another limitation of our study is that we did not use validated questionnaires to evaluate improvements in quality of life. Future research could incorporate measures such as the 36-Item Short Form Survey to provide a more comprehensive assessment of patient outcomes beyond pain reduction.

CONCLUSIONS

This study shows that occipital nerve decompression is an effective treatment option to address occipital pain in patients with TN. Frontal and temporal decompression surgery in patients with a diagnosis of TN was less successful, and critical reflection of patient eligibility for surgery using evidence-based diagnostic tools is warranted in this patient subgroup to differentiate distal and proximal trigeminal nerve compression.

Lisa Gfrerer, MD, PhD
Division of Plastic and Reconstructive Surgery
Weill Cornell Medicine
425 East 61st Street
New York, NY 10065
E-mail: lisa.gfrerer@gmail.com

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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