Pain-free and pain-controlled survival after sectioning the nervus intermedius in nervus intermedius neuralgia: a single-institution review

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OBJECTIVE Nervus intermedius neuralgia (NIN) or geniculate neuralgia is a rare facial pain condition consisting of sharp, lancinating pain deep in the ear and can occur alongside trigeminal neuralgia (TN). Studies on the clinical presentation, intraoperative findings, and ultimately postoperative outcomes are extremely limited. The aim of this study was to examine the clinical presentation and surgical findings, and determine pain-free survival after sectioning of the nervus intermedius (NI).

METHODS The authors conducted a retrospective chart review and survey of patients who were diagnosed with NIN at one institution and who underwent neurosurgical interventions. Pain-free survival was determined through chart review and phone interviews using a modified facial pain and quality of life questionnaire and represented as Kaplan-Meier curves.

RESULTS The authors found 15 patients with NIN who underwent microsurgical intervention performed by two surgeons from 2002 to 2016 at a single institution. Fourteen of these patients underwent sectioning of the NI, and 8 of 14 had concomitant TN. Five patients had visible neurovascular compression (NVC) of the NI by the anterior inferior cerebellar artery in most cases where NVC was found. The most common postoperative complaints were dizziness and vertigo, diplopia, ear fullness, tinnitus, and temporary facial nerve palsy. Thirteen of the 14 patients reportedly experienced pain relief immediately after surgery. The mean length of follow-up was 6.41 years (range 8 months to 14.5 years). Overall recurrence of any pain was 42% (6 of 14), and 4 patients (isolated NIN that received NI sectioning alone) reported their pain was the same or worse than before surgery at longest follow-up. The median pain-free survival was 4.82 years ± 14.85 months. The median pain-controlled survival was 6.22 years ± 15.78 months.

CONCLUSIONS In this retrospective review, sectioning of the NI produced no major complications, such as permanent facial weakness or deafness, and was effective for patients when performed in addition to other procedures. After sectioning of the NI, patients experienced 4.8 years pain free and experienced 6.2 years of less pain than before surgery. Alone, sectioning of the NI was not effective. The pathophysiology of NIN is not entirely understood. It appears that neurovascular compression plays only a minor role in the syndrome and there is a high degree of overlap with TN.

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KEYWORDS nervus intermedius neuralgia; geniculate neuralgia; pain-free survival; Kaplan-Meier curve; functional neurosurgery; pain

Nervus intermedius neuralgia (NIN), also known as geniculate neuralgia, is a rare pain condition characterized by paroxysmal, deep ear pain. Patients commonly describe the pain as “being stabbed in the ear with an icepick.” These attacks can be debilitating and socially isolating. The posterior wall of the auditory canal and the superficial ear drum are common trigger zones for the paroxysms—for example, by loud noises or cold wind. Sensory innervation to the skin of the external ear and auditory canal is complex, including contributions from cra-
nial nerves (CNs) V, IX, and X and the nervus intermedius (NI) and upper cervical dorsal roots. After ruling out other nonneuralgic forms of otalgia, this complicated innervation can lead to diagnostic uncertainty surrounding the culprit nerve in primary otalgia. 

Recent systematic reviews in otolaryngology and neurosurgery reveal a significant gap in the NIN literature, with fewer than 150 total cases published between 1932 and 2012. Most of these are single case reports or case series. The exact etiology of NIN is unclear. There is no quintessential culprit artery causing compression of the nerve, although a number of cases of neurovascular compression (NVC) of the NI by the anterior inferior cerebellar artery (AICA) and posterior inferior cerebellar artery (PICA) have been reported. In the remainder of cases, the vast majority, the etiology is unknown.

Given the complexity of the innervation of the inner ear and lack of understanding of the pathophysiology in NIN, surgical management is extremely variable. The most common surgical treatment of NIN is to section the NI with or without destruction of the geniculate ganglion. Surgical sectioning is a procedure in which the NI is isolated from CNs VII and VIII and transected. Described first in 1909 by Clark and Taylor, this procedure was performed under local anesthesia, with or without sectioning of the glossopharyngeal nerve. For patients with known NVC, a microvascular decompression (MVD) is sometimes performed instead of, or as an adjunct to, sectioning the NI. MVD is a procedure in which the culprit vessel is identified, and a piece of Teflon padding is placed between the vessel and the nerve. A variety of combinations of procedures has been reported in the literature, making comparisons of outcomes between studies difficult.

In our literature search, only 3 reports examined quality of life (QOL) and long-term outcomes after sectioning of the NI, and of those, there was a heterogeneity of procedures performed. No studies, to our knowledge, have published pain-free survival results following sectioning of the NI. The goal of this retrospective study was to examine the QOL, pain-free survival, and pain-controlled survival after sectioning of the NI in NIN.

Methods
Retrospective Chart Review
This was a retrospective chart review and survey of patients who were diagnosed with NIN (ICD-10-CM code G51.1; geniculate ganglionitis) at a single institution from 2002 to 2016 and who underwent a neurosurgical intervention(s) (Fig. 1). The institutional review board approved the study, and verbal consent to participate in the survey was obtained at the time of the survey. Demographic data such as age at presentation, sex, coexisting cranial neuralgias, preoperative pain characteristics and intraoperative findings were obtained by chart review.

Telephone Survey
Patients were contacted by telephone by a nonindependent investigator after their surgery. The length of time from their operation until being contacted was recorded as the length of follow-up. Patients were asked if their ear pain had returned, the nature of the pain, postoperative changes in pain quality, current pain medication use, postoperative complications, and their satisfaction with the procedure. If patients could not be reached, then the presence of pain and side effects and need for medication were recorded at longest follow-up by chart review.

Quality of Life
Quality of life was assessed using a modified Brief Pain Inventory (BPI)–Facial instrument and Barrow Neurological Institute (BNI) Pain Intensity Scale (Table 1). Patients were asked to describe their pain as follows: no pain with no pain medication, occasional pain without medication, mild or infrequent pain controlled with medication, mild or infrequent pain not controlled with medication, or uncontrolled pain, which is similar to the BNI pain score. Patients were asked if they were taking medications and if they had any side effects from these medications. Side effects from the surgery were recorded, and patients were asked to determine if these side effects were tolerable or intolerable. There were 20 QOL questions, on a scale of 1 to 10, where 1 indicates that the pain does not interfere with these activities and 10 indicates that the pain interferes all the time; 10 questions were based on general activities (e.g., mood, normal work, and relationships), and the other 10 questions were based on face-specific activities (e.g., eating a meal, brushing teeth, and talking). These questions were based on the general activities and facial activities portion of the BPI-Facial questionnaire. The BPI-Facial scale is validated and reliable; however, the BNI composite pain score is not, making this novel, adapted questionnaire not validated as well. There are no validated questionnaires for NIN, but the BPI-Facial questionnaire addresses both face- and ear-related activities common to TN and NIN. Pain-free survival was defined as the time between surgery and the return of any ear pain. Pain-controlled survival was defined as the length of time between surgery and when their ear pain was at the same or worse intensity than before surgery.

Statistical Analysis
Kaplan-Meier curves were constructed based on pain-free and pain-controlled survival. Two-tailed independent Student t-tests were used to compare pain-free survival and time to failure between patients with and without NVC. Significance was determined at the 0.05 level. All data were analyzed using SPSS (IBM, version 24, 2016).

Results
Demographics
Fifteen patients were diagnosed with NIN at a single institution and underwent a neurosurgical procedure performed by two neurosurgeons. Mean age at diagnosis was 44.86 years (range 13–71 years). There were 4 males and 11 females. Eight of 15 patients had left-sided pain and 7 had right-sided pain. All patients described their pain as lancinating, intermittent, and stabbing deep in their inner ear and 4 described a constant burning pain. Almost half (n = 8) of the patients had concomitant trigeminal neuralgia (TN), and 2 patients had glossopharyngeal neuralgia.
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**Major Provocations**

Major provocations for deep ear pain were eating and chewing (n = 5), touching the ear or pressure (n = 3), and cold temperatures or wind (n = 2). Five patients had some pain relief with gabapentin, 2 from carbamazepine, and 2 from opioids. Six patients had no relief with any medication (as documented in the medical chart). On average, patients were taking 2.4 medications for their pain prior to surgery, which most commonly included gabapentin, carbamazepine, oxycodone, amitriptyline, baclofen, acetaminophen, and hydromorphone.

**Operations**

All surgical interventions were performed using a standard retrosigmoid approach. One patient with NI and TN refused to undergo sectioning of the NI and instead underwent an MVD of CN V only. All of the remaining 14 patients underwent sectioning of the NI (Table 2). Four patients underwent a sectioning of the NI only. Of those 14, 5 also had an MVD of the NI for NVC—4 NIs were compressed by the AICA and 1 by the labyrinthine artery. Eight patients had an MVD or internal neurolysis of CN V as well. Two patients had sectioning of CN IX and the upper rootlets of CN X for GN. Two patients had an MVD of the CN IX/X complex due to NVC by the PICA and a large vertebral artery.

**Quality of Life**

Quality of life data were obtained by phone questionnaire or chart review from all 15 patients. Four of the 15 patients were not able to be contacted and therefore their last clinic follow-up was documented. The mean length of follow-up was 6.41 years, ranging from 8 months to 14.5 years. Thirteen of the 14 patients who underwent sectioning of the NI experienced immediate pain relief at the 2-week follow-up. Overall, recurrence of any ear pain occurred in 42.9% (6 out of 14) of the patients and

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**FIG. 1.** Flow diagram of patient selection.
28.6% (4 out of 14) claimed their pain was the same or worse than before surgery. The average BNI pain score was 3 in those whose pain returned. Of those whose pain was worse than before surgery, patients experienced attacks all/most of the time and it affected their daily living all/most of the time. The face-related activities most impacted by the NIN pain from the BPI-Facial questionnaire were “touching your face” and “smiling or laughing,” on average affecting this activity about half the time (Table 3). NIN affected general activity, mood, relationships with others, sleep, and enjoyment of life more than half of the time in these patients (Table 4).

Two of the 6 patients reported that their ear pain was triggered by cold and viruses; they were forced to wear a hat at all hours and even moved to a warmer climate. Three of the 6 patients remained on medication after surgery, which included oxycodone, prednisone, and gabapentin. After surgery, the average number of medications per patient was 0.76 (range 0–5), with 9 of 14 (64%) patients not requiring any medication. Of those on medication for their ear pain, only one experienced any side effects.

Reported Surgical Side Effects

A majority of patients (92.8%; n = 14) experienced side effects immediately after surgery, most commonly vertigo, ear fullness, increased ipsilateral lacrimation, tinnitus, and transient CN VII palsy (Table 1). Decreased ipsilateral hearing was reported by 3 patients with no case of total hearing loss. The degree of hearing loss, by audiogram, was not established on these patients per chart review. Most side effects were transient, and of the ones that were permanent, most respondents (60%) found them to be tolerable. Five patients reported facial numbness, 3 of whom had an MVD or IN of CN V. Only 2 patients reported their facial numbness as interfering with their life. Eight patients (80%; n = 10) reported that if they could go back in time, they would choose to have the surgery again.

One patient underwent reoperation after ear and facial pain did not resolve. In this patient’s first surgery, the NI was sectioned and the AICA decompressed from the CN VII/VIII complex. At the second surgery, a small vessel was found compressing portio minor (motor roots) of CN V and a single fascicle of the NI that was previously unseen. After MVD of CN V and sectioning of this fascicle, the patient had excellent pain relief until being lost to follow-up 2.5 years later.

The patient who refused NI sectioning continued to have deep inner ear pain at the same intensity as before surgery, which bothered the patient most of the time and affected daily life most of the time, but it was not severe enough to pursue surgical intervention or medical treatment. Sleep, enjoyment of life, mood, and touching of the face were the QOL parameters most affected (score greater than 8 of 10). When asked, the patient said they would have had the MVD and NI sectioning.

6. How would you best describe your pain now? □ YES □ NO
   - No pain with no medication □ YES □ NO
   - No pain with medication □ YES □ NO
   - Mild infrequent pain with no medications □ YES □ NO
   - Some pain with medication, but to unsatisfactory or intolerable levels □ YES □ NO
   - Worse/intolerable pain (than before surgery) with medication □ YES □ NO

7. On a scale of 1-10 (where 1 is no interference, and 10 is maximum interference) how does your facial pain interfere with your: (Note circle response)
   - General activity
   - Mood
   - Walking ability
   - Normal work
   - Relationships with other people
   - Sleep
   - Enjoyment of Life

8. On a scale of 1-10 (where 1 is no interference, and 10 is maximum interference) how does your facial pain interfere with specific facial activities: (Note circle response)
   - Eating a meal
   - Touching your face
   - Brushing or flossing teeth
   - Smiling or laughing
   - Talking
   - Opening your mouth widely
   - Eating hard foods
   - Putting on make-up (women) or Shaving your face (men)
Six of the 14 patients had an isolated diagnosis of NIN and underwent sectioning of the NI. All 6 of these patients reported deep inner ear pain, and 3 reported radiation into the throat. Two of these patients also underwent an MVD of the NI given the presence of the labyrinthine artery in one and the AICA in the other case compressing the nerve. Two other patients underwent multiple procedures: one had an MVD of CN V and the other underwent sectioning of CN IX and MVD of CN V. Both of these patients underwent multiple procedures for the complexity of their pain syndromes. In total, 4 of these 6 patients with isolated NIN underwent NI sectioning alone. All 4 patients were contacted by phone. Ear pain returned in all 4 patients, and when their pain returned, it was at the same or worse intensity than before surgery. The time until pain returned was between 6 months and 2 years. Two of these patients underwent additional procedures, including a repeat sectioning of the NI and MVD and sectioning of CN IX. Since their second procedures, these 2 patients continue to have ear pain at the same or worse intensity than before their first operation.

**Pain-Free Survival**

Of the 15 patients, 13 were included in the Kaplan-Meier curve (the patient who did not receive a sectioning of the NI and the patient who experienced no pain relief at the 2-week follow-up were omitted). The median pain-
free survival was 4.82 years (57.89 ± 14.85 months) (Fig. 2). The median pain-controlled survival was 6.22 years (74.64 ± 15.78 months). There was no difference in pain-free or pain-controlled survival between patients with and without NVC: 27.2 months versus 20.5 months (p = 0.681) and 37.2 versus 21.3 months (p = 0.336), respectively (Fig. 2).

Discussion

Three studies have evaluated long-term pain relief following microsurgical intervention for NIN. Only two of these\textsuperscript{5,9} reported quantifiable data. In the landmark study by Lovely and Jannetta,\textsuperscript{5} 14 patients underwent surgical management of NIN, 7 of whom had a sectioning of the NI without destruction of the geniculate ganglion, and the average follow-up was 28.5 months (range 4 weeks to 10 years). Of the 10 patients that had follow-up greater than a year, 3 patients had > 90% pain relief, 6 patients had at least 75% improvement in their pain, and 1 patient experienced < 25% pain relief after surgery.\textsuperscript{5} Only 3 of the 14 patients were diagnosed with isolated NIN, half the number of isolated cases in this paper, all of whom underwent multiple procedures, including MVD of CNs IX and X. Similarly, Rupa et al. found pain relief in 72% of their 14 patients who underwent NI sectioning with or without destruction of the geniculate ganglion at a mean follow-up of 3.3 years.\textsuperscript{9} Only 2 of the 14 had an isolated diagnosis of NIN, and all of these patients underwent a heterogeneous set of procedures on CNs V, IX, and X, as well as the NI and the geniculate ganglion. In one of the larger studies on NIN, Pulec found “excellent long-term outcomes” with sectioning of the NI and destruction of the geniculate ganglion in 48 patients, although excellent outcome was not defined and the average length of follow-up was not reported.\textsuperscript{7}

In the present retrospective study, we report that sectioning of the NI is a safe, without major complications, and effective procedure for the treatment of NIN in combined syndromes. Most patients (72%; n = 14), found full or partial pain relief from this procedure at longest follow-up (Fig. 2). Patients experienced an average of 4.8 years pain free and 6.2 years experiencing less pain than before surgery. Of the patients who experienced a return of their facial pain, only half needed medication to address this pain. A majority of patients, 13 of 14, experienced side effects immediately after surgery, but most of these were temporary, and of the side effects that persisted, they were tolerated by 60% of patients at longest follow-up. There were no cases of major complications such as facial palsy or deafness. Additionally, most patients (80%) were satisfied with the surgery and would have it over again. This study is the first to report pain-free and pain-controlled survival after sectioning of the NI for NIN and has the longest follow-up of any study of patients with NIN to our knowledge.\textsuperscript{5,7,9}

As a stand-alone treatment for NIN, sectioning of the NI does not seem to be effective. All four of our patients with an isolated diagnosis of NIN and sectioning of the NI had their ear pain return. There could be many reasons for this result. Identifying the NI among CNs VII and VIII can be difficult, and therefore fascicles may be missed, leading to continuation of deep ear pain.\textsuperscript{7,9} One patient in this cohort had continued ear pain after sectioning of the NI and later underwent repeat sectioning in which a fascicle of the NI was missed initially. After sectioning the missed fascicle, the patient’s ear pain resolved at lon-

### Table 4. QOL scale modified from the BPI-Facial

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Eating a Meal</th>
<th>Touching Your Face</th>
<th>Brushing Your Teeth</th>
<th>Smiling or Laughing</th>
<th>Talking</th>
<th>Opening Mouth Widely</th>
<th>Eating Hard Food</th>
<th>Putting on Makeup or Shaving Your Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIN2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NIN5</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>NIN6</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>NIN8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NIN10</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NIN13</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
<td>5</td>
<td>2.5</td>
<td>4.7</td>
<td>3.2</td>
<td>3.8</td>
<td>4.2</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Scored on a scale of 1 to 10, where 1 is pain that does not interfere with this activity and 10 is pain that interferes with the activity all of the time (n = 6).

![Figure 2](image-url)\textsuperscript{2} Pain-free and pain-controlled survival for 13 patients with NIN who underwent sectioning of the NI.
gest follow-up. Another contributing factor could be the complex innervation of the inner ear such that patients’ ear pain is not confined to the NI. In this case performing a sectioning of CN IX or MVD of CN V in addition to sectioning the NI is effective in treating ear pain. Rupa et al. reported their best results for primary otalgia when the NI was sectioned with CN IX and the upper two rootlets of CN X, although this cohort was only 2 patients and lacks quantifiable evidence. All 3 cases of isolated NIN in the Lovely and Jannetta cohort underwent surgery on multiple cranial nerves including the NI and CN IX with reportedly good outcomes. Sectioning of the NI alone may not address the pathophysiology of the condition, and therefore addressing multiple cranial nerves such as V and IX may be necessary to treat the deep inner ear pain.

Deep ear pain may be another manifestation of TN in some patients. In our cohort with TN and NIN, a combination of MVD of CN V and sectioning of the NI helped resolve patients’ inner ear pain. In the patient with TN and deep ear pain, thought to be concomitant NIN, who underwent MVD of CN V without sectioning the NI, the deep ear pain remained at the same intensity and quality. This is just one case, but it could point toward sectioning of the NI as a useful adjunct procedure for TN accompanied by deep ear pain. In 2 cases reported on by Lovely and Jannetta, although the patients underwent multiple procedures to CNs V and IX, relief of deep ear pain was not achieved until the NI was sectioned. These examples are too few to draw generalizations, and a larger population with TN with deep ear pain would need to be studied to determine the effectiveness of sectioning the NI as an adjunct procedure. Though it is not an effective stand-alone treatment for NIN, its benefit in combined syndromes seems to be clear.

In our study, we found one-third of patients had NVC of the NI, most commonly by the AICA. NVC of the NI has been reported in the literature in multiple case reports. The most common arteries reported are the AICA and the PICA. In these case reports, MVD of the NI without sectioning was sufficient to produce pain relief. Anatomically, NVC is most likely to occur proximally near the brainstem. As the NI exits the pontomedullary junction, it is in the form of 1–5 roots and travels through the cerebellopontine angle cistern, adhering to CN VIII. As noted by others, we have found that the dissection of the NI away from the CN VII/VII complex is most easily accomplished at the intracerebral portion of the nerve. While there are case reports that have advocated isolated MVD for NVC of the NI, at this institution, we perform both MVD and nerve sectioning. Of the case reports advocating MVD, their patients experienced pain relief at long-term follow-up of 1–4 years, although pain recurrence is not known past 4 years, unlike our patients with NVC. Ultimately, there was no difference in the number of pain-free months in those with and without NVC, indicating that patients with NVC do not respond better or worse than those without NVC to surgery.

There is debate in the literature as to whether destruction of the geniculate ganglion is needed. Pulec argued that the geniculate ganglion needed to be excised because some sensory fibers passed through the ganglion and traveled to the brain by the motor part of CN VII without going through the NI. While Rupa et al. evaluated patients who underwent sectioning both with and without geniculate ganglion destruction, there was no comparison made regarding outcome by type of surgery. Lovely and Jannetta did not destroy the geniculate ganglion and found excellent long-term pain relief without the additional risk of impairing lacrimation and facial nerve palsy. In most of our patients, pain relief was good without sectioning of the geniculate ganglion. Most side effects from the surgery were temporary or tolerable, and, as such, the added destruction of the geniculate ganglion is questionable. It is possible that performing the added middle cranial fossa approach to destroy the ganglion adds unnecessary surgical morbidity. However, to formally assess the benefit of additional destruction of the geniculate ganglion, a comparison study with calculated pain-free survival would be beneficial.

Over half of the patients in this study’s cohort were diagnosed with another facial pain syndrome. Two patients were even diagnosed with the trifecta: TN, GN, and NIN. This finding is not limited to our population and has been reported previously. This could reflect the difficulty in the diagnosis of primary otalgia due to the convoluted innervation of the inner ear. As there are multiple nerves innervating this region, it is challenging to parse out whether the pain is originating from the throat and radiating to the ear or if they are actually two separate problems. Another hypothesis is that patients with CN neuralgias may be predisposed to other CN neuralgias. Genetic and molecular expression aberrations in patients with TN have been reported. Not all patients with NVC of CN V express the phenotype of the disease and not all patients with TN have NVC. Therefore, it would be reasonable to postulate that a similar genetic or molecular expression component applies to NIN and other CN neuralgias.

**Limitations**

This is a retrospective chart review study with inherent disadvantages and bias. In addition, the telephone follow-up was completed by a nonindependent investigator. The study is also limited by a lack of uniformity of procedures performed. Some patients not only had sectioning and/or MVD of the NI, but also other procedures to treat their concomitant TN and GN. This, again, has been observed in other studies. Our cohort had 4 patients with an isolated diagnosis of NIN with intervention on the NI, which is a small number to draw concrete conclusions from. It would be beneficial to study a larger population, in the form of a multiinstitutional study, due to the rarity of NIN. However, we argue that the high rate of coexisting CN neuralgias is a significant feature of the NIN phenotype, and thus their outcomes should be considered together. An additional limitation is small sample size (n = 15). Although there was no difference in pain-free survival between patients with and without NVC, our small sample size precludes the ability to draw meaningful conclusions. Further analysis is warranted in larger patient populations. Finally, the study is limited by the telephone survey methodology with missing data in 4 patients as they were unable to be contacted. Complications and adverse effects of the survey
were collected subjectively through the telephone survey without objective follow-up, such as audiograms for hearing loss. Beyond the inherent recall bias in survey data, a survey that is not validated for NIN was used. While the BPI-Facial pain scale is validated in its original form to assess QOL after surgery, the modifications added change the tools’ validity. We chose to modify these to better address outcomes in the NIN population, and further validation in this setting is warranted in future research.

Conclusions
Sectioning of the NI in NIN is a safe—producing no major complications—and effective procedure for NIN in combined syndromes, resulting in approximately 4 years of complete pain relief and 6 years of the same or less pain than before surgery. All 4 patients who underwent an isolated sectioning of the NI had their pain return quickly, indicating that sectioning the NI may not be an effective stand-alone treatment for NIN. Side effects of surgery are common, but they tended to be transient, and there was no incidence of facial weakness or deafness. Only 33% of this cohort demonstrated NVC of the NI, suggesting that this is not the most common etiology of this condition.

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References

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Dr. Raslan reports being a consultant for Abbott.

Author Contributions
Conception and design: Burchiel, Holste, Raslan. Acquisition of data: Holste. Analysis and interpretation of data: Holste, Raslan. Drafting the article: Holste, Hardaway. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Burchiel. Statistical analysis: Holste, Raslan. Study supervision: Burchiel, Raslan.

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