

# Impact of Nerve Surgery on Opioid and Medication Use in Patients with Chronic Nerve Injuries

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**Introduction:** Limited information is available regarding the ability of nerve surgery to affect medication use patterns in patients with chronic pain or neuropathy due to nerve injury.

**Methods:** A retrospective survey was distributed to all operative patients (N = 767) from a single nerve surgeon's practice between 2014 and 2020. Data collected included demographics, specifics of the injury and symptoms, medication and opioid use before surgery, and medication/opioid use following surgery.

**Results:** Out of the 767 patients, 209 (27.2%) completed the survey. Average age was 48.8 (SD = 19.1) years; 68.9% female and 31.1% male. More than 50% of the patients took at least three medications. More than 50% of the patients after surgery did not need medication or had significant reduction; 54.1% of the patients took opioid medication daily, and 97.3% of patients reported that narcotic medications did not resolve their problem. Patients rated the effectiveness (Likert scale 0–10) of opioid medications in general at an average  $3.25 \pm 2.03$ . Of patients who took opioids regularly, 61.6% reported a negative effect of these medications on daily or professional activities. After surgery, more than 50% of the patients did not need opioids or had a significant reduction in opioid usage.

**Conclusions:** Untreated nerve injuries lead to ongoing chronic pain, explaining why medications are mostly ineffective in eliminating symptoms. In this study, nerve surgery targeting the anatomical source of symptoms effectively reduced both opioid and nonopioid medication use. (*Plast Reconstr Surg Glob Open* 2021;9:e3789; doi: 10.1097/GOX.0000000000003789; Published online 7 September 2021.)

## INTRODUCTION

Chronic nerve injuries may be considered those injuries that manifest in patients seeking outpatient care. These may result from an untreated acute injury to a nerve, or may result from a progressive chronic process, such as untreated compression neuropathy. Untreated injuries to peripheral nerves may act as chronic pain generators, which can have a debilitating effect on physical functioning and quality of life. Pain management with medications is therefore frequently employed, including with opioid medications.<sup>1</sup> For various reasons, chronic

pharmacologic pain management with opioids and other medications is often used even for conditions where surgical interventions are available to correct the underlying anatomical cause of the chronic pain.

Recently, the national opioid crisis has highlighted the potential individual and societal harms associated with chronic opioid use.<sup>2–5</sup> Therefore, interventions with the potential to reduce the chronic use of opioids have become a topical matter. Patients with neuropathic pain (NP) are more likely than patients with non-neuropathic chronic pain to be taking opioids and multiple pain medications, but they report less pain relief from their medications.<sup>6</sup> Interestingly, despite an increased focus on opioid alternatives, consideration of nerve surgery as an option to address NP is largely absent from medical algorithms and consensus recommendations.<sup>7–11</sup>

Given that nerve surgery is a rational, traditional, and literature-supported approach to correcting injuries of peripheral nerves, whether due to trauma or compression neuropathy,<sup>12–18</sup> this study was undertaken to evaluate specifically whether nerve surgery was associated with a postoperative reduction in chronic medication and opioid use among patients with chronic pain due to nerve injuries. We hypothesized that nerve surgery, across a broad

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This study was approved by an independent IRB.

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spectrum of conditions, would reduce patients' dependence on chronic medication and opioid use.

**METHODS**

An IRB-approved retrospective survey from a single nerve surgeon's ambulatory referral-based practice was distributed to all patients (N = 767) who underwent surgery for NP or dysfunction between 2014 and 2019. The minimum follow-up period was 1 year. Data collected included demographics, etiology of the injury, concurrent clinical conditions, specifics of nerve injury/disorder type, duration and severity of the symptoms at presentation, medications and opioids used before surgery to treat the nerve problem (eg, not medications for other chronic medical conditions), effects of opioid use on quality of life, medication/opioid use following surgery, severity of symptoms following surgery, and complications of surgery.

**RESULTS**

**Characteristics of the Patient Group**

Out of the 767 patients, 209 (27.2%) completed the survey. Average age was 48.8 (SD = 19.1) years; 68.9% were women and 31.1% men. Notable comorbidities included anxiety (31.1%), depression (28.2%), and thyroid disorders (11.0%) (Table 1).

Anatomical areas affected included the head and neck in 119 patients (56.9%), lower extremity in 62 (29.7%), upper extremity in 19 (9.1%), trunk/groin in six (2.9%), breast in two (1%), and multiple areas in one (0.5%) (Table 1); 16.3% had spontaneous onset, 53.1% had suffered a physical trauma, and 30.6% were precipitated by previous surgery (Fig. 1A and B).

Presenting symptoms included pain 192 (91.9%), numbness 82 (39.2%), tingling/burning 129 (61.7%), muscle weakness 45 (21.5%), difficulty using arm or leg 46 (22%), headaches/migraines 111 (53.1%), and others less than 10% (Table 1).

Affected quality of life variables included sleep pattern in 78.5% of the patients, social life in 87.5%, extremity function in 44.0%, personal/social life in 87.6%, professional activities in 71.8%, and mood/spirits in 83.7%.

The duration of symptoms before presentation is distributed as follows: less than 3 months (3.8%), 3–6 months (8.1%), 6–12 months (20.1%), 1–2 years (25.8%), 3–5 years (21.1%), 5–10 years (10.0%), and more than 10 years (11.0%). Sixty-eight percent (95% CI = [61.2%, 74.2%]) of patients had symptoms for more than 1 year before surgery.

The percentage of patients who reported the severity of symptoms at presentation as being profound was 86.1% (95% CI = [80.7%, 90.5%]). At the time of presentation, the mean ± SD Likert scale (0–10) severity score was 8.1 ± 2.0 (median = 9). After the nerve surgery, the mean ± SD Likert scale (0–10) severity score was 3.2 ± 3.0 (median = 2). The change (reduction mean ± SD = 4.9 ± 3.6; median = 5) was statistically significant (P < 0.001 by Wilcoxon signed rank test).

Surgery types included neurolysis in 108 (51.67%) patients, neuroma excision with implantation to muscle in

**Table 1. Patient Demographics**

Age	Avg 48.8	SD 19.1
	No. Patients	Percentage of Patients
Survey respondents	209	27.2
Sex		
Male	65	31.1
Female	144	68.9
Comorbidities		
No comorbidities	77	36.8
Anxiety	65	31.1
Depression	59	28.2
Peripheral vascular disease	31	14.8
Thyroid disorders	23	11
Autoimmune diseases	18	8.6
Diabetes	13	6.2
Cancer	10	4.8
Presenting symptoms		
Pain	192	91.9
Numbness	82	39.2
Tingling/burning	129	61.7
Muscle weakness	45	21.5
Difficulty using arm or leg	46	22
Headaches/migraines	111	53.1
	<b>All (N = 767)</b>	<b>Responded (N = 209)</b>
<b>Surgery type</b>		
Neurolysis	455 (59.32%)	108 (51.67%)
Neuroma excision + implantation to muscle	42 (5.48%)	7 (3.33%)
Excision and reconstruction	256 (33.38%)	90 (42.86%)
Nerve tumor	14 (1.83%)	4 (1.90%)
	<b>All (N = 767)</b>	<b>Responded (N = 209)</b>
<b>Anatomical area</b>		
Head and neck	484 (63.10%)	119 (56.9%)
Breast/chest	4 (0.52%)	2 (0.96%)
Upper extremity	71 (9.26%)	20 (9.57%)
Lower extremity	163 (21.25%)	62 (29.67%)
Trunk/groin	45 (5.87%)	6 (2.87%)

seven (3.33%), neuroma excision and nerve reconstruction in 90 (42.86%), and excision of nerve tumor in four (1.90%) (Table 1).

**Medication Use before and after Surgery**

The total number of all medications used daily before nerve surgery was: zero in 10.5% of patients, one to two in 31.1%, three to four in 28.2%, five to six in 16.3%, seven to eight in 7.2%, nine to 10 in 2.4%, 11–12 in 1.4%, and more than 12 in 2.9%. Significantly, more than 50% of the patients took at least three medications daily (P = 0.018). All patients reported that medications did not resolve their problem, with an average effectiveness (Likert scale 0–10) of mean ± SD = 2.5 ± 1.9 (median = 2) (Fig. 2).

After surgery, patients reported their use of all medications as follows: (1) for those who did not need to take medications before the surgery, 0% had to take medication after the surgery and (2) for those who took medications before the surgery, medication use was completely eliminated in 34.2% of patients, significantly reduced in 25.1%, moderately reduced in 13.4%, somewhat reduced in 7.5%, not affected in 17.1%, and made worse in 2.7%. Significantly, more than 50% of the patients after surgery did not need medication or had significant reduction (P = 0.0008) (Fig. 3).

Total daily opioid medication use before surgery was zero in 45.9% of patients, one to three in 39.2%, four to

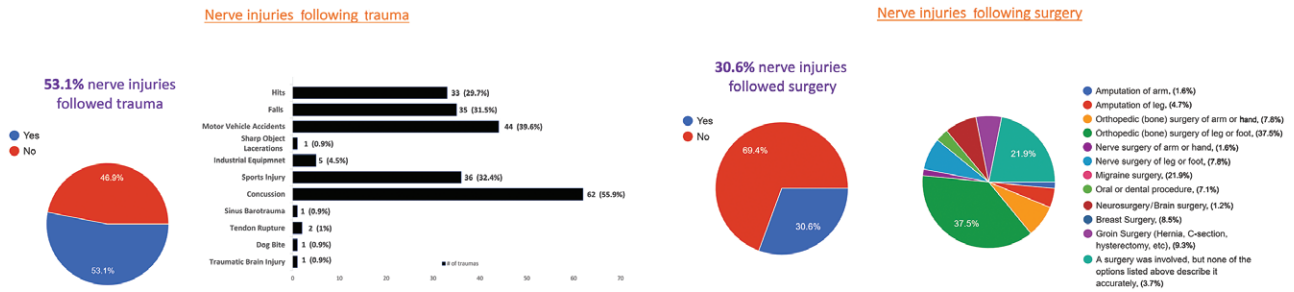


Fig. 1. Spectrum of posttraumatic nerve injuries included. A, nerve injuries following trauma. B, nerve injuries following surgery.

six in 12.0%, seven to nine in 1.9%, and 10–13 in 0.96%. The percentage of patients who took opioid medication daily was 54.1% (95% CI = [47.1%, 61.0%]), and 97.3% (95% CI = [92.3%, 99.4%]) of patients reported that opioid medications did not resolve their problem. Patients rated the effectiveness (Likert scale 0–10) of opioid medications in general at an average (mean ± SD) of 3.25 ± 2.03 (median = 3). Of patients who took opioids regularly, 61.6% (95% CI = [51.9%, 70.6%]) reported a negative effect of these medications on daily or professional activities (Fig. 4).

After surgery, patients reported their use of opioids as follows: (1) for those who did not need to take opioids before the surgery, 1% took opioids after the surgery; (2) for those who took opioids before the surgery, opioid use was completely eliminated in 56.3% of patients, significantly reduced in 12.5%, moderately reduced in 8.9%, somewhat reduced in 6.3%, not affected in 14.3%, and made worse in 1.8%. Significantly, more than 50% of the patients after surgery no longer required opioid medications or had significant reduction in use ( $P = 2.9 \times 10^{-13}$ ) (Fig. 5).

Complication rate was 8.3% and all complications were minor (delayed wound healing, dehiscence due to noncompliance, infection requiring oral antibiotics), with no complications requiring hospitalization or return to the operating room

### DISCUSSION

Opioid medications have increasingly been recognized to have detrimental effects both on the individual patient and society.<sup>2,3,19</sup> Although chronic opioid use is a frequently observed clinical phenomenon in patients with chronic pain due to nerve injuries,<sup>1,7–9,20</sup> surprisingly few studies have attempted to quantify the degree of medication and opioid use in such patients,<sup>21</sup> or commented on whether nerve surgery has an effect on reducing opioid consumption in these patients.<sup>15</sup> Generally speaking, the commonly employed nonsurgical modalities for treatment of chronic pain (including medications, but also interventional procedures such as neuromodulation or ablation) are mechanistically unable to reverse the underlying anatomical cause of pain and instead are directed at controlling or “masking” symptoms. It is therefore conceptually

### Total medication use and effectiveness in patients with chronic nerve pain

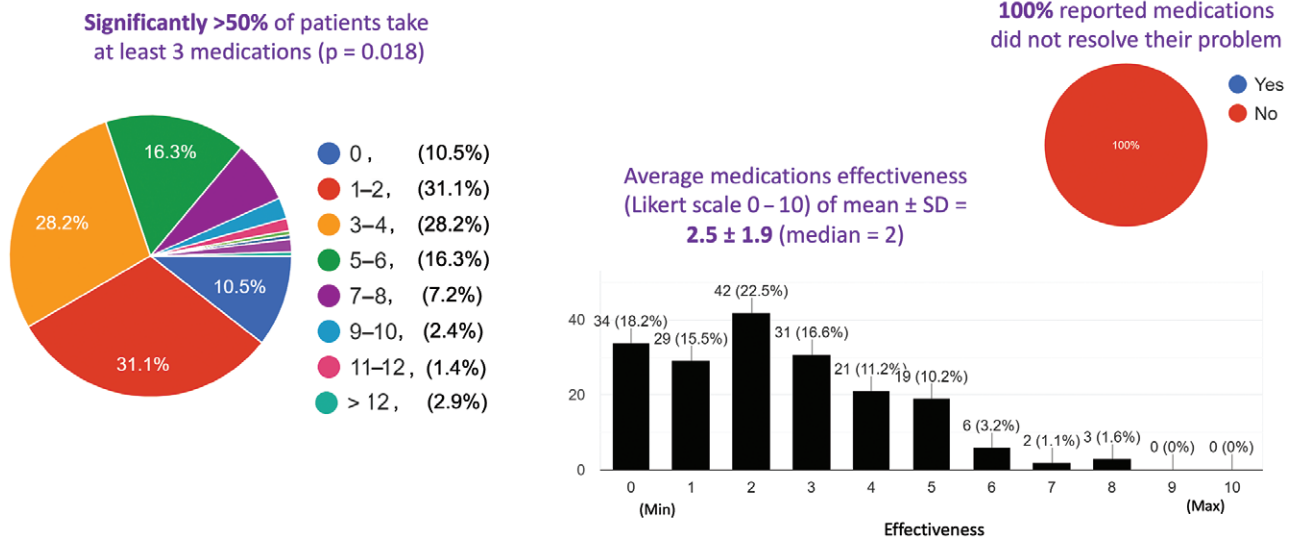
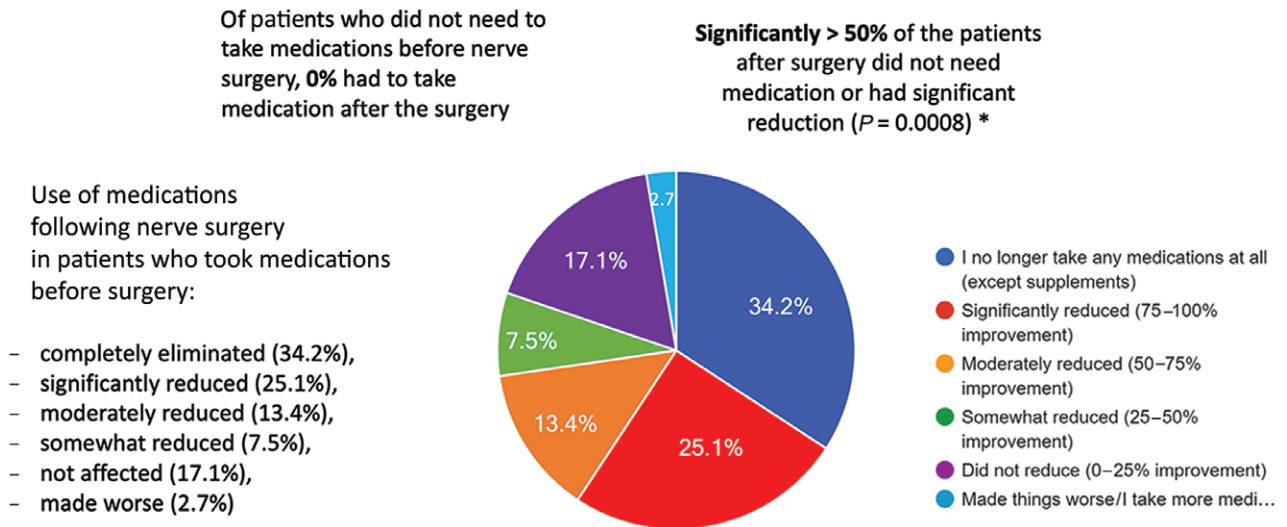


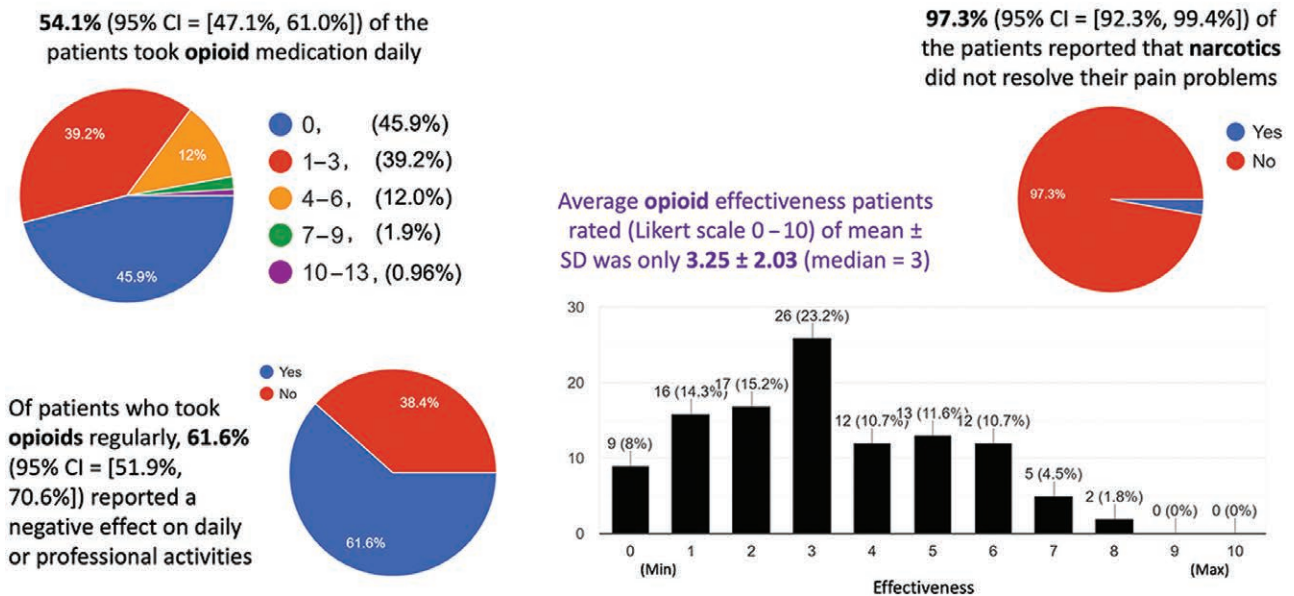
Fig. 2. Medications taken to address nerve-related problem before surgery.

Effect of nerve surgery on total medications use in patients with chronic nerve pain



**Fig. 3.** Effect of nerve surgery on total nerve-related medication use in patients with chronic nerve pain. \*By exact binomial test.

Daily opioid use and effectiveness in patients with chronic nerve pain



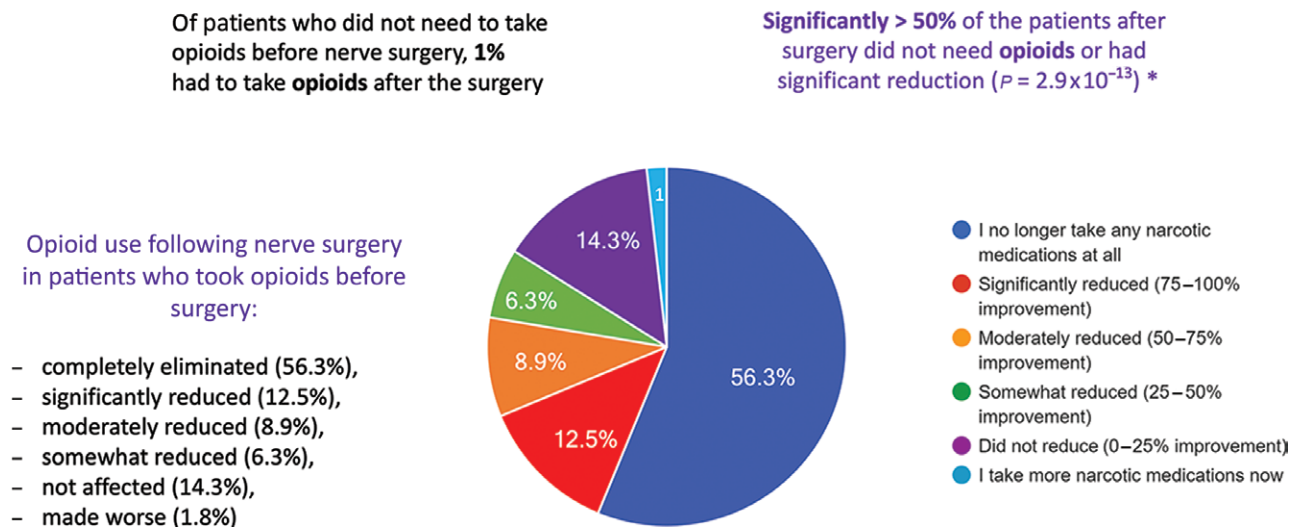
**Fig. 4.** Total daily opioid use and effectiveness before surgery in patients with chronic nerve pain.

straightforward to suppose that the unresolved underlying mechanisms of pain generation will require ongoing use of medications, contributing to the chronic use of opioids that has recently been labeled as a crisis in our society.

Nerve surgery, in contradistinction, is directed at reversing the causative anatomical lesion responsible for producing chronic pain. Generally speaking, nerve surgery has

been demonstrated to be effective in treating chronic NP due to a wide variety of underlying traumatic or compressive etiologies.<sup>12–15,22</sup> Over the past two decades of clinical practice in nerve surgery, we have informally observed the frequently present burden of chronic medication and opioid use among preoperative patients, and the phenomenon of reduction in medication/opioid use postoperatively



Effect of nerve surgery on daily opioid use in patients with chronic nerve pain

**Fig. 5.** Effect of nerve surgery on daily opioid use in patients with chronic nerve pain. \*By exact binomial test.

in some cases. We therefore conducted this study within our own nerve surgery practice to verify and quantify to what degree nerve surgery may have an effect on the reduction of total medications and/or opioids in patients with chronic pain, functional nerve deficits, or compression neuropathy

This study was designed as a retrospective survey to achieve the longest possible follow-up after surgery. Although outcomes such as pain scores were included in the study results, this study was not intended to be a validated outcomes study regarding the effectiveness of nerve surgery for relief of symptoms. Rather, traditional outcome measures were only included to give some idea of the correlation between medication reduction and patient-reported outcomes for effectiveness of surgery.

The primary findings of this study support the hypothesis that nerve surgery is effective in significantly reducing dependence on chronic medications, including opioids across a broad range of peripheral nerve pathologies where surgery is indicated. Specifically, medication use was completely eliminated in 34.2% of patients, and more than 50% of patients after surgery either did not need medication or had at least a meaningful reduction in the number of medications needed, a result that reached statistical significance (Fig. 3). With regards to opioids in particular, opioid use was completely eliminated in 56.3% of patients, and more than 50% of patients after surgery either no longer required opioid medications or had a meaningful reduction in use (Fig. 5). It is interesting to note that 68% of the patients had symptoms for more than 1 year before surgery, which suggests that even delayed surgical intervention may have an effect on opioid reduction; a question that has been persistent in the literature.<sup>23</sup>

Although it may seem obvious, it is also relevant that nearly 100% of patients self-reported that medications “did

not resolve their pain problem” (Figs. 2 and 4). Being a referral-based surgical practice, our group may have self-selected for a predominance of patients in whom medications were not effective. However, guidelines from the European Federation of Neurological Societies regarding pharmacotherapy for NP suggest that only 30%–40% of patients with chronic NP achieved pain relief of greater than 50% with pharmacotherapy.<sup>10,11</sup> In other published cross-sectional surveys of patients with NP, three-fourths had moderate or severe pain despite taking oral medications for their pain.<sup>24–29</sup>

Mechanistically, in the case of an anatomically identifiable lesion of a peripheral nerve, medications are not able to reverse the underlying process leading to pain or dysfunction. However, there is certainly evidence in the literature, including from randomized controlled trials, that a variety of drugs including opioids are capable of improving symptoms of NP, including the level of pain itself.<sup>24</sup> Several of the first-line medications for NP, including tricyclic antidepressants, duloxetine, gabapentin, pregabalin, and opioids have all produced statistically significant improvements in sleep compared to placebo. Overall mood, anxiety, and depression have also been shown to improve in randomized controlled trial subjects treated with those same drugs. However, there is evidence to suggest that such associations are not at all consistent among patients with NP and may also be dependent on underlying intrinsic patient factors, making pharmacologic treatment of NP an often frustrating, trial-and-error process.<sup>24</sup> Among patients in the United Kingdom followed for the first year after being diagnosed with NP, only 30%–50% had stable treatment regimens.<sup>30</sup> Furthermore, among Swedish patients with peripheral NP, two of three had discontinued at least one treatment because of poor pain relief, adverse effects, or both.<sup>31</sup>

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Our patients subjectively rated the average “effectiveness” of opioid treatment for NP as 3.25 on a Likert scale of 0–10. Furthermore, 61.6% of our patients reported that opioids had a negative effect on daily or professional activities (Fig. 4). Taken together, these results suggest a high degree of ineffectiveness as well as a morbidity to treatment with opioid medications in patients referred for surgery, with the potential morbidity being both personal and socioeconomic.<sup>19,32</sup>

The reported low effectiveness and notable morbidity of opioids in our respondents may be due to selection bias, given that all of our patients were referred for surgery likely because other treatments were ineffective. However, both findings also support the concept that medications are unable to reverse etiology and thereby, when used as a sole form of treatment, create a condition of chronic medication use, whereas surgery is effective in altering the underlying etiology and therefore may reduce the need for chronic treatment. Finally, one may speculate that promoting the paradigm of chronic pharmacologic treatment of conditions with an underlying surgically treatable cause may cause a doubly negative effect on the patient by effectively converting a potentially curable condition into a chronic condition that both burdens the patient with medication side effects while also putting the onus of finding effective surgical treatment on them.

Limitations of the study include a relatively low response rate, which may have to do with attrition of respondents over a long study period. There were differences in survey response rates among surgery types; however, the percentage of respondents by surgery type generally approximated the percentage of the patient population who had undergone that surgery type.

The broad spectrum of conditions treated may skew results, as some nerve injury conditions may have been non-painful and predominantly related to loss of function. These limitations preclude us from drawing definitive conclusions regarding the magnitude of the effect of nerve surgery on decreasing opioid consumption. On the other hand, these data clearly indicate a positive effect of nerve surgery involvement, in general, in reducing medication and opioid use in chronic nerve injury patients. Despite some study limitations, our findings do serve to call awareness to the issues of polypharmacy and opioid use in patients with chronic pain related to nerve injuries, and suggest that surgical treatment is a potential means of reducing reliance on medications in this population. More rigorous prospective studies are indicated to confirm these preliminary conclusions.

## CONCLUSIONS

Chronic use of opioids is increasingly considered to be detrimental to patients and society. In this study, we demonstrated quantifiably that nerve surgery can reduce chronic dependence on opioids and other medications among patients with NP due to various types of nerve injuries, and of varying duration. Nerve surgery should be considered alongside pharmacologic treatments within medical treatment algorithms as an option for chronic NP due to nerve injury. Future prospective studies are indicated to confirm these findings.

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