Chronic nerve injuries and delays in surgical treatment negatively impact patient-reported quality of life

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Chronic Nerve Injuries and Delays in Surgical Treatment Negatively Impact Patient-reported Quality of Life

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**Background:** Little emphasis has been paid to characterize quality of life (QoL) burdens experienced by patients seeking surgical treatment for nerve injuries and neuropathic pain.

**Methods:** A cross-sectional survey was distributed to all patients (N = 767) from a single nerve surgeon’s practice between 2014 and 2019. Data collected included demographics, specifics of the injury and symptoms, time to referral, and effects of the injury, surgery, and timing of surgery on QoL.

**Results:** Of the 767 patients, 209 (27.2%) completed the survey. Average age was 48.8 years; 68.9% of patients were women and 31.1% men. At presentation, 68% had experienced symptoms for more than 1 year; 86.1% reported severity as being profound; 97.6% reported QoL was at least moderately negatively impacted by nerve injury; 70% felt they should have been referred earlier for surgical evaluation; 51.2% were not told that nerve surgery was an option for their problem; 83.1% felt that earlier referral would have improved their QoL. After surgery, symptoms were significantly mitigated in 55.5% of the patients, moderately mitigated in 21.5%. Patients reported QoL was significantly (59.8%) or at least moderately (76.6%) improved by nerve surgery.

**Conclusions:** The majority of patients reported that nerve injuries imparted a moderate to severe impact on QoL, and that surgical treatment improved QoL. Most patients felt that earlier referral for surgical intervention would have led to better outcome and positively impacted QoL. Interdisciplinary treatment algorithms, including a role for surgical intervention, may be helpful in facilitating timely diagnosis, referral, and thus improved outcomes. (Plast Reconstr Surg Glob Open 2021;9:e3570; doi: 10.1097/GOX.0000000000003570; Published online 21 May 2021.)

**INTRODUCTION**

As peripheral nerves generate the signals that govern both pain and peripheral motor function, dysfunction of peripheral nerves is inherently debilitating. 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.

Nerve injuries often present with an obvious loss of function that may impart substantial disability and impair activities of daily living, ability to work, or to pursue recreation. Untreated chronic neuropathic pain due to nerve injury, although impossible to define objectively by an examiner, may have a multitude of equally disabling effects on an individual’s quality of life (QoL). Chronic pain may induce or exacerbate psychological stress and depression, and may result in chronic emotional, behavioral, and even personality changes. Furthermore, chronic pain may interfere with ability to work, sleep, engage in social activities, and ability to pursue leisure or hobbies. Pain has been demonstrated to be specifically predictive of negative changes in QoL and mood, and the reported intensity of a patient’s pain has been shown to be predictive of the level of disability imparted by the nerve injury.

Time since injury is also predictive of the level of disability, and this time may be increased by delays in referral, treatment and attempted treatment with ineffective modalities, whether medical or interventional.

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Medications (opioids, neuroleptics, and antidepressants) used chronically for pain related to nerve injuries may themselves lead to further undesirable effects. Although neuropathic pain has been repeatedly demonstrated to represent a negative burden on QoL in patients treated pharmacologically, there is surprisingly little information available in the literature examining QoL burdens reported by patients seeking nerve surgery, or examining the effect of nerve surgery on QoL. We therefore sought to characterize the burden of nerve injuries on QoL in patients seeking surgery for these conditions. The objectives of this study were (i) to characterize patient-reported effects of chronic nerve injuries on quality of life, across a broad range of conditions present for ambulatory treatment; (ii) to examine the effect of nerve surgery on patient-reported QoL, and (iii) to characterize patients’ feelings about timing of referral to a surgeon and delays in treatment.

**METHODS**

An institutional review board (IRB)-approved retrospective cross-sectional survey was distributed to all patients (N = 767) from a single nerve surgeon’s (ID) ambulatory referral-based practice between 2014 and 2019. Minimum follow up was 1 year. Data collected included demographics, reason of injury, concurrent clinical conditions, specifics of nerve injury/disorder type, symptom of the injury and the severity, time to referral, severity of the symptoms, how the QoL was affected, feelings regarding the process of finding treatment, post-surgery impacts on symptoms and QoL, and complications of surgery.

**RESULTS**

Characteristics of the Patient Group

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). The composition of the response group versus non-responders to the survey is characterized in Table 2.

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 < 10% (Table 1).

Specifically, the symptoms affecting quality of life 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% (Table 1).

The duration of symptom before presentation is distributed as: <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 >10 years (11.0%). An estimated 68% (95% confidence interval [CI] = [61.2%, 74.2%]) of the patients had symptoms for more than 1 year before surgery (Figs. 1, 2).

**Table 1. Patient Demographics**

| Age | No. of Patients | Percentage of Patients |
|-----|----------------|------------------------|
| Survey respondents | 209 | 27.2 |
| Gender |  |  |
| Men | 65 | 31.1 |
| Women | 144 | 68.9 |
| Comorbidities |  |  |
| No major 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 |

**Table 2. Characteristics of Response Group versus Non-responders**

| Age | Mean ± SD | Responded (N = 209) | Did Not Respond (N = 558) | P |
|-----|-----------|---------------------|--------------------------|---|
| All (N = 767) |  |  |  |  |
| Gender |  |  |  |  |
| Women | 503 (65.58%) | 144 (68.90%) | 359 (64.33%) | 0.267 |
| WC versus insurance |  |  |  |  |
| WC | 110 (14.34%) | 28 (13.40%) | 82 (14.70%) | 0.729 |
| Surgery type |  |  |  |  |
| Neurolysis | 455 (59.32%) | 108 (51.67%) | 347 (62.18%) | 0.01 |
| Neuroma excision + implantation to muscle | 42 (5.48%) | 7 (3.33%) | 35 (6.27%) | 0.15 |
| Excision and reconstruction | 256 (33.38%) | 90 (42.86%) | 166 (29.74%) | 0.00 |
| Nerve tumor | 14 (1.83%) | 4 (1.90%) | 10 (1.79%) | 1.00 |
| Anatomical area |  |  |  |  |
| Head & neck | 484 (63.10%) | 118 (56.46%) | 366 (65.59%) | 0.02 |
| Breast/chest | 4 (0.52%) | 2 (0.96%) | 2 (0.36%) | 0.30 |
| Upper extremity | 71 (9.26%) | 20 (9.57%) | 51 (9.14%) | 0.89 |
| Lower extremity | 163 (21.25%) | 62 (29.67%) | 101 (18.10%) | 0.00 |
| Trunk/groin | 45 (5.87%) | 6 (2.87%) | 38 (6.99%) | 0.03 |

WC, worker’s compensation.
Anatomical areas affected included: head and neck in 119 patients (56.9%), lower extremity in 62 (29.7%), upper extremity in 19 (9.1%), trunk/groin in 6 (2.9%), breast in 2 (1%), and multiple areas in 1 (0.5%) (Table 1). An estimated 16.3% had spontaneous onset, 53.1% had suffered a physical trauma, and 30.6% were precipitated by previous surgery.

Surgery types included neurolysis in 108 (51.67%) patients, neuroma excision with implantation to muscle in 7 (3.33%), neuroma excision and nerve reconstruction in 90 (42.86%), and excision of nerve tumor in 4 (1.90%) (Table 2).

**Severity of Symptoms before and after Surgery**

86.1% (95% CI = [80.7%, 90.5%]) of the patients reported the severity of symptoms at presentation being profound, with a mean ± SD preoperative Likert scale pain score of 8.1 ± 2 (median 9) (Fig. 3). After the surgery, 9.1% (95% CI = [5.6%, 13.8%]) reported that the severity of symptoms was profound, a 77% reduction from pre-surgery symptoms ($P < 0.001$ by McNemar’s test). The mean ± SD Likert scale (0–10) pain 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 the Wilcoxon Rank Sum test) (Fig. 4).
Patients reported that symptoms were significantly mitigated in 55.5% of the patients, moderately mitigated in 21.5%, somewhat mitigated in 10.0%, and 12.9% felt that surgery was not helpful (Fig. 5).

**Quality of Life before and after Surgery**

84.7% (95% CI = [79.1%, 89.3%]) reported their QoL was significantly negatively impacted by their nerve injury, and 97.6% (95% CI = [94.5%, 99.2%]) reported their QoL was at least moderately negatively impacted by their nerve injury, which suggests with 95% statistical confidence that more than 79.1% of the patients’ QoL was significantly negatively impacted by their nerve injury (Fig. 6). 59.8% (95% CI = [52.8%, 66.5%]) reported their QoL was significantly improved by their nerve surgery treatment; and 76.6% (95% CI = [70.2%, 82.1%]) reported their QoL was at least moderately improved by their nerve surgery treatment (Fig. 7).

The surgery positively affected: 68.3% of those whose sleep pattern was affected by the symptom; 75.0% of those whose extremity function was affected by the symptom; 74.9% of those whose personal/social life was
affected by the symptom; 66.0% of those whose professional productivity was affected by the symptom; and 76.6% of those whose mood/spirits was affected by the symptom (Fig. 7).

**Treatment Experiences before Surgery and Feelings on the Referral Process**

With regard to treatment experiences before the presentation, the distribution of total number of physicians seen: 0 (0%), 1–3 (28.7%), 4–6 (42.1%), 7–10 (16.7%), 11–15 (7.7%), 16–20 (4.8%) (Fig. 8). In total, 70.0% (95% CI = [63.1%, 76.0%]) felt they should have been referred earlier; 51.2% (95% CI = [44.2%, 58.2%]) were not told that nerve surgery was an option for their problem; and 68.8% (95% CI = [62.0%, 75.0%]) were told that nothing could be done. An estimated 83.1% (95% CI = [77.3%, 87.9%]) felt that earlier referral would have improved their quality of life, and 88.5% (95% CI = [83.3%, 92.5%]) stated that if they could go back in time, they would have the surgery again (Figs. 9–11).
The average overall satisfaction with nerve surgery was 8.04/10—18.8% rated 10/10 (Fig. 12). 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 (Fig. 13).

**DISCUSSION**

Traditional outcomes reporting in nerve surgery focuses on objective clinical motor or sensory grading systems. However, patients themselves may experience the impact of nerve injuries and outcome of nerve surgeries very differently. The pain and bodily dysfunction that clinicians seek to characterize are in reality only some of the contributors to the overall negative impact that nerve injuries create on a patient’s quality of life. Pain and sensory/motor dysfunction are a problem because they create a negative change in patients’ standard of living that they are unable to overcome without medical intervention. This negative chapter in a patient’s life story can be unduly extended when treating clinicians do not diagnose the problem correctly or do not refer the patient for appropriate nerve surgery intervention, which is often the...
only means of permanently restoring or at least approximating the patient’s prior quality of life.

It has been our observation over 2 decades of clinical practice that patients’ interpretation of their experience does not always correlate with either objective outcome measures, or validated surrogate measures aimed at quantifying QoL variables. Therefore, this study was designed to directly query surgical patients’ perceptions of the quality of life changes imparted by nerve injuries, and the effect of nerve surgery on quality of life. This study was administered as a cross-sectional survey intended to capture patient perceptions following the conclusion of their experience with nerve surgery. Although outcomes such as pain scores were included in the study results, this study was not intended to be a validated outcomes study for pain or physical function. Rather, traditional outcome measures were only included to allow patients to give context to their subjective QoL responses, which were the primary data collected. The goal, simply, was to understand to what extent nerve injuries had a negative impact on quality of life, and whether nerve surgery broadly was helpful in improving QoL for these patients.

Findings of this study included characterization of the symptoms associated with nerve injuries that patients felt affected their QoL, the subjective severity of these symptoms, and their impact on QoL (Table 1, Figs. 1, 3, 6). Respondents in our study reported chronic nerve injuries affected the QoL domains of sleep, social functioning, and global QoL; findings that are in concordance with other studies that have used the SF-36 (short form 36) to demonstrate an impact of medically-treated neuropathic pain on these domains. Our patients further reported impacts on professional activities, mood, and ambulation or use of extremity (as we queried patients with a broader set of

**Specialists & Referral Issues Prior to Nerve Surgery Evaluation**

- **70.0% (95% CI = [63.1%, 76.0%])** felt they should have been referred earlier
- **51.2% (95% CI = [44.2%, 58.2%])** were not told that nerve surgery was an option for their problem

**Fig. 9.** Patients’ feelings and experiences regarding referral process.

- **33.8% (95% CI = [30.1%, 39.8%])** were told no nerve intervention needed, nerve will recover, but it might take a year or more
- **68.8% (95% CI = [62.0%, 75.0%])** were told that nothing could be done for their nerve problem

**Fig. 10.** Patients’ feelings regarding availability of information for treatment options.
nerve injuries rather than only those causing neuropathic pain) (Table 1).

A majority of our patients reported chronic symptoms that were substantially disabling in their frequency, duration, and severity (Figs. 1, 3). Regarding the negative impact of nerve injury symptoms on QoL, 97.6% of patients reported at least a moderate impact, and 84.7% reported a significant impact on QoL (Fig. 6). The finding of a negative impact on QoL is in agreement with prior population survey studies, wherein respondents with medically-treated neuropathic pain had lower SF-36 HR-QOL (short form 36 health-related quality of life) scores than patients with non-neuropathic pain, even after adjusting for pain score.9,10 Taken together, our findings regarding duration and severity of symptoms, and level of impact on QoL indicate that this subset of nerve injury patients presenting for ambulatory nerve surgery had relatively chronic, established conditions with a pronounced negative effect on QoL; perhaps because they are referred for surgery after other conditions have been tried and failed.

Although there are a multitude of published studies that report the outcome of nerve surgery in terms of VAS (visual analog scale) pain reduction and changes in a variety of physical functioning metrics, there are surprisingly few reports of the direct effect of nerve surgery on QoL.11 Yang et al demonstrated an improvement in SF-36 scores in patients undergoing lower extremity nerve decompression surgery for painful diabetic neuropathy, in a case series of 19 patients.12 Domeshek et al reported a statistically significant improvement in QoL rated on a VAS scale in a case series of 70 patients with upper and lower extremity neuromas.13 However, a meta-analysis examining surgical treatment of painful neuromas did not identify meaningful reporting on QoL from other publications.11 Our results echo those of the few other studies reporting

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Specialists & Referral Issues Prior to Nerve Surgery Evaluation

77% (95% CI = [70.7%, 82.6%]) thought their provider to whom they first brought-up nerve related problem did not manage them in a timely manner

83.1% (95% CI = [77.3%, 87.9%]) felt that earlier referral would provide more complete outcome and improved their quality of life

Fig. 11. Patients’ feelings on timeliness of referral and outcome.

Patient Satisfaction with Nerve Surgery Outcomes

88.5% (95% CI = [83.3%, 92.5%]) stated that if they could go back in time, they would have the surgery again

8.04/10: overall average satisfaction

(48.8% rated 10/10)

Fig. 12. Patient satisfaction with nerve surgery.
improvement in QoL following surgical treatment for nerve injuries, and our results are notable in comparison for examining both a larger cohort of patients and a broader range of chronic nerve injury conditions. The majority of respondents in our study reported that nerve surgery improved QoL to a significant (59.8%) or at least moderate (76.6%) degree, and at least 65% of patients reported specific improvements in each of the domains of sleep pattern, extremity function, personal/social life, professional productivity, and mood (Fig. 7). These data support the existing body of literature demonstrating that nerve injuries are associated with a negative impact on quality of life14–16 and that surgical treatment of nerve injuries is an important consideration in patients’ care when a reasonable short period of conservative measures has not led to resolution of symptoms.3,11,13,17

The study findings also provided a description of the process of finding care for nerve injuries. Survey results confirmed that most patients had seen multiple specialists before referral for nerve surgery evaluation, and that many patients experienced subjective frustrations and delays during the referral process before ultimately undergoing evaluation by a nerve surgeon (Figs. 9–11). The majority of patients felt that they should have been referred earlier (Fig. 9), and most patients either were not told that nerve surgery was an option for them, or were told that nothing could be done for their problem (Figs. 9, 10). Notably, 77% of patients felt that they were not managed in a timely manner and 83.1% felt that earlier referral would have improved their quality of life. We are not able to confirm with this study whether earlier surgical treatment would have improved outcomes of our patients in terms of pain reduction; however, Kato et al have demonstrated that delayed surgical treatment of brachial plexus injuries are associated with poorer pain outcomes in addition to the expected poorer functional outcomes.18 These findings appear to validate the assumption of many nerve surgeons that closer interdisciplinary care of nerve injury patients would reduce suffering for the patient and hasten recovery in their personal, daily, professional, and social lives.

The overall importance of our findings should be interpreted in the context of interdisciplinary management and of the existing literature regarding management of chronic neuropathic pain. Outside of surgical literature and practice, the term “neuropathic pain” is broad, and includes pain resulting from phenomena varying from nonsurgical conditions such as postherpetic neuralgia, to conditions such as neuroma that result from nerve injury and have been repeatedly demonstrated to respond to surgery.19 The predominance of published literature regarding management of chronic neuropathic pain is medical or pharmacologic in scope and tends not to consider conditions leading to neuropathic pain as surgically-treatable injuries of nerves. Thus, even though parallel surgical literature offers clear recommendations on timing for surgical intervention for all types of nerve injuries, none of this literature is included in commonly referenced treatment algorithms,20 guidelines,21–24 and society consensus statements25 that are used to guide medical treatment of chronic nerve injuries.

There are multiple examples of conditions whose pathophysiology and treatment are viewed differently by medical and surgical providers, and for which a shared terminology and concept of disease would likely improve multidisciplinary management to the benefit of patients. Our study population included, for instance, those with neuromas undergoing excision or excision and reconstruction, those with painful diabetic neuropathy related to nerve compression, those with complex regional pain syndrome, and those with chronic headaches related to
sensory nerve entrapment or injury. Multiple publications have shown that surgical treatment of neuromas improves pain\(^1\,\,2\,\,3\,\,4\) and quality of life.\(^5\) Surgical literature is also replete with studies demonstrating improvements in pain,\(^5\,\,6\,\,7\) sensibility,\(^8\,\,9\,\,10\) and quality of life\(^11\) after nerve decompression in painful diabetic neuropathy—a condition for which only pharmacologic treatment is traditionally considered in nonsurgical literature,\(^12\,\,13\) despite extensive publications examining its negative impact on quality of life.\(^14\,\,15\) Chronic migraine headaches, although traditionally considered a source of neuropathic pain only treatable with chronic medication, have also been repeatedly demonstrated to be treatable with surgical decompression of entrapped sensory nerves,\(^16\,\,17\) or excision of neuroma in cases of nerve injury masquerading as headaches such as in postoperative headaches following acoustic neuroma excision that are associated with occipital nerve neuromas.\(^18\,\,19\) The same circumstance has lately been recognized in phantom limb pain—a condition traditionally treated pharmacologically that has now been shown to be treatable with nerve transfer surgery.\(^20\,\,21\) The greatest barrier to effective multidisciplinary treatment for these conditions seems to be one of terminology and ideation, and it may be this barrier that is partially responsible for our findings of delayed presentation for surgical treatment. It stands to reason, therefore, that unified algorithms with common terminology and incorporating both medical and surgical recommendations for treatment would improve patients’ outcomes and decrease the quality of life burden experienced by patients with chronic nerve injuries.

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 patients who had undergone that surgery type. The retrospective nature of the survey relies on patient recall, possibly affecting outcome interpretation. However, ultimately, it is the patient’s final impression of the experience after completion of treatment that we are concerned with. Arguably, the lack of a validated outcomes measure for quality of life is a weakness; however, we were specifically interested in patients’ responses to direct questions regarding QoL and the referral process, rather than validated but less specific surrogate measures. Despite these study limitations, this preliminary report does serve to call awareness to the issues of decreased quality of life and delays in referral for surgical care in patients suffering from chronic nerve injuries. Future prospective studies utilizing validated patient-reported outcome tools that measure QoL would add further perspective to these preliminary but significant findings.

**CONCLUSIONS**

Among patients with nerve injury referred for nerve surgery, most report decreased quality of life associated with their injury. Nerve injury patients also report that the referral process of finding appropriate surgical care may be frustrating or protracted, and that this further negatively impacts their ultimate outcome and quality of life. Greater recognition of the quality of life burden that nerve injury patients face while finding appropriate surgical care for their condition should highlight the need for closer interdisciplinary management of these patients. Treatment algorithms incorporating both medical and surgical perspectives on the treatment of chronic neuropathic pain would improve interdisciplinary management.

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