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Cervical Medial Branch Radiofrequency Neurotomy in New Zealand

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Abstract

Objective. The objective of this study was to determine the effectiveness of cervical medial branch radiofrequency neurotomy (RFN) performed by two practitioners trained according to rigorous guidelines.

Design. The study was designed as a prospective, outcome study of consecutive patients with chronic neck pain treated in a community setting.

Interventions. A total of 104 patients, selected on the basis of complete relief of pain following controlled, diagnostic, medial branch blocks, were treated with RFN according to the guidelines of the International Spine Intervention Society.

Outcome Measures. Successful outcome was defined as complete relief of pain, or at least 80% relief, for at least 6 months, with complete restoration of activities of daily living, no need for any further health care, and return to work. Patients who failed to meet any of these criteria were deemed to have failed treatment.

Results. In the two practices, 74% and 61% of patients achieved a successful outcome. Relief lasted 17–20 months from the first RFN, and 15 months for repeat treatments. Allowing for repeat treatment, patients maintained relief for a median duration of 20–26 months, with some 60% still having relief at follow-up.

Conclusion. Cervical RFN can be very effective when performed in a rigorous manner in appropriately selected patients. Chronic neck pain, mediated by the cervical medial branches, can be temporarily, but completely, relieved and patients fully restored to desired activities of daily living, if treated with RFN.

Key Words. Chronic Pain; Neck Pain; Radiofrequency; Neurotomy

Introduction

Cervical medial branch radiofrequency neurotomy (RFN) is a treatment for a particular form of neck pain. It is indicated for neck pain that is relieved by controlled, diagnostic blocks of one or more of the medial branches of the cervical dorsal rami, and which ostensibly arises from the zygapophysial joint or joints innervated by the nerves anaesthetized [1–4]. When effective, the procedure relieves pain completely, restores normal activities, and eliminates the need for other neck pain-related health care [3,5,6]. Its efficacy was established in a double-blind, placebo-controlled trial [5]; and follow-up studies have shown that it is fully successful in about 70% of patients treated, with relief lasting for a median duration of about 400 days [3,5,6]. If pain recurs, the treatment can be repeated in order to reinstate relief [3,5–9]. When applied to the third occipital nerve, which is the superficial medial branch of the C3 dorsal ramus, RFN has been particularly effective for the relief of cervicogenic headache [7,8].

Most of the studies concerning the effectiveness of cervical RFN have been produced by groups or individuals associated with those who originally developed the procedure [3,5–8]. This has raised a concern as to whether others are able to reproduce the same success [10]. The few studies reported by others have not emulated the original results.

One study reported that 37% of 63 patients achieved greater than 70% relief for periods ranging between 3 and 34 months [11]. Another reported that 56% of 169 patients achieved at least 70% relief for 3 months [12]. Neither study reported the proportion of patients with complete relief of pain. A third study reported four of 46 patients having complete relief at 12 months, and a further 12 patients having greater than 70% relief [13]. A fourth study achieved complete relief in four of 28 patients at 12 months [14], but these latter authors acknowledged that they used a protocol different from that of the original authors [5,6]. They treated patients who had less than complete relief of pain following diagnostic blocks, used smaller electrodes, and performed fewer lesions using trajectories different to those originally described [14].

None of the replication studies used the same techniques as the original authors. The question, therefore, arises if the same results can be achieved if the original protocols are followed. The present study addressed this question.

Methods

During 2004, two of the authors (JM, JB) were trained by the fifth author (NB) in the rigorous performance of cervical RFN according to the standards prescribed by the International Spine Intervention Society [1,2]. All consecutive patients who underwent cervical RFN after the period of training until December 2009 were prospectively followed. In accordance with the paradigm of cervical RFN, patients were selected for treatment only if they had complete relief of their pain following controlled, diagnostic, medial branch blocks.

Medial branch blocks were performed on patients who presented with neck pain, with or without referred pain to the head or shoulder girdle, and in whom it was suspected that the source of the patient's pain may be a cervical zygapophysial joint. Diagnostic blocks were initiated at segments suggested by matching the distribution of the patient's pain with the maps described by Cooper et al. [15]. If initial blocks proved negative, further blocks were performed at adjacent segments above or below. By following this protocol, blocks were positive at the initial segments selected in 48% of patients. Two blocks were required to find the symptomatic segment in 20% of patients, three blocks in 27%, and more than three blocks in 5% of patients.

Diagnostic blocks were performed using either lignocaine or bupivacaine, and the physician, the assessor of the response, and the patient were all blinded as to which local anesthetic was used. A positive response was confirmed by repeating the blocks with the local anesthetic that was not used for the first procedure. Patients selected for treatment had complete relief from pain on both occasions and were able to perform movements and activities that would usually aggravate their pain without restriction. Duration of relief following each diagnostic block was not used as a criterion for eligibility, for it has been shown that duration of relief has little effect on the diagnostic confidence (posttest probability) of comparative local anesthetic blocks [16].

All cervical RFN procedures were carried out with 10-cm 16-gauge (1.6 mm diameter) Cosman RRE "Ray" electrodes with 5-mm exposed tips. The electrodes were placed parallel to the medial branches (Figures 1 and 2), and sufficient lesions were created in the sagittal plane and in an oblique plane 30° to sagittal to cover the likely location of the nerves [1]. The number of lesions required in each plane depended on the patient's individual anatomy but was most commonly two and, particularly for the third occipital nerve, three or four. The temperature for the oblique lesions was 80° and the temperature for the sagittal lesions was 85°, and these temperatures were maintained for 90 seconds for each lesion. The time taken to complete treatment varies according to the radiographic anatomy and the build of the patient, and it typically takes at least 1 hour to treat one medial branch, and therefore 2 hours to denervate a typical zygapophysial joint, and at least 1.5 hours to complete treatment of the third occipital nerve.

The patients were assessed and treated in each of two suburban practices conducted by practitioners with a vocational interest in musculoskeletal pain. The outcomes were assessed, at 1, 3, 6, 9, and 12 months after treatment, and at 6-month intervals thereafter at each of the practices, respectively, by one of two primary care physicians (AM, BL), and also by a research nurse, who were not involved in the treatment of the patients. The data collected were independently assessed and analyzed by the fifth author (NB).

Before treatment, patients recorded their pain scores using a visual analog scale or verbal, numerical pain rating scale [17–19]; they nominated four activities of daily living that were impeded by their pain and which most dearly they would want restored [20–22]; and they recorded their work status and what health care they were using for their pain. Follow-up was undertaken either during subsequent face-to-face consultations or by telephone, at which time patients were asked to report their pain scores, their activities of daily living, work status and their use of other health care.

Pain usually returns gradually when the effect of the treatment wears off and the duration of relief was defined as the time from the provision of the treatment until the time that the patient estimated that the pain had returned to 50% of its pretreatment level of intensity.

Outcomes were defined categorically. In order to be rated as having a successful outcome patients had to report complete relief of pain or at least 80% relief; restore all of their desired activities of daily living; require no other health care for their neck pain; and return to work if they had not previously been working. Any other combination of response was considered a failure. Occasional exceptions were indulged. For example, return to work was excused if the patient could not work for socioeconomic reasons or

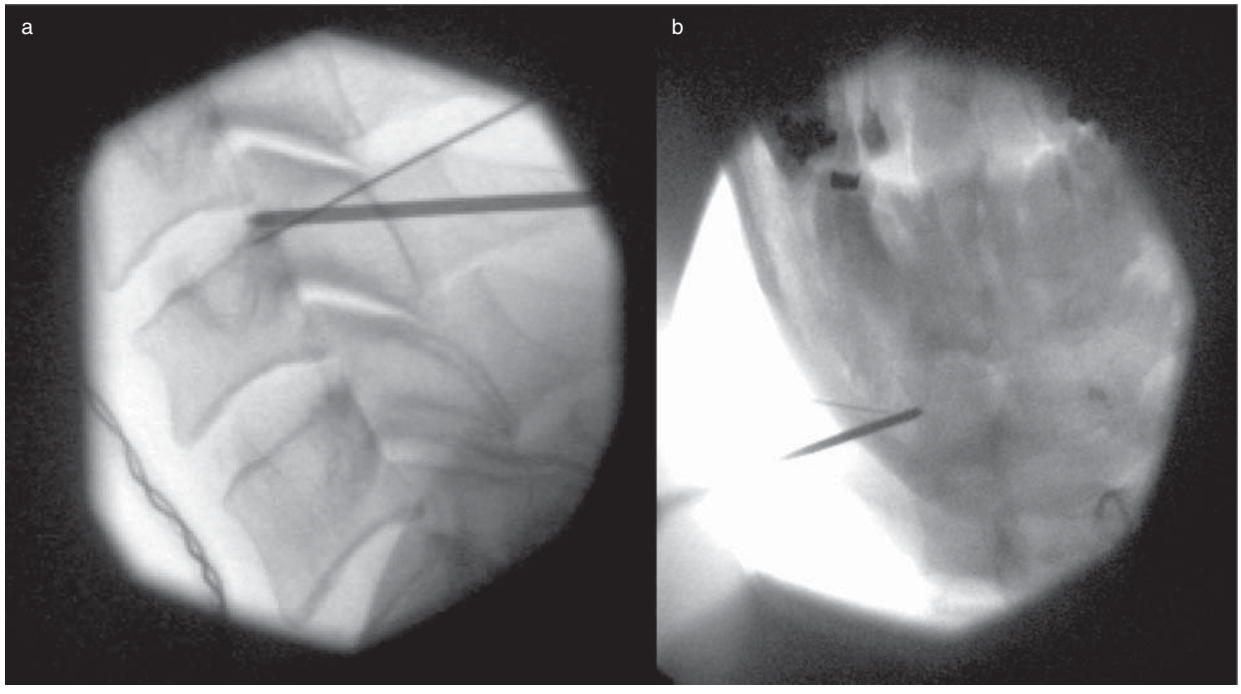

Figure 1 Images demonstrating electrode placement for oblique pass, C5 radiofrequency neurotomy. (a) Lateral view. (b) Anteroposterior view.

for other health reasons, but provided that pain was completely relieved, all activities had been restored, and no other health care was required. Patients were allowed to use analgesics if they had some other pain problem that was not treated. Patients were allowed to use over-the counter-analgesics for any remnant pain, but they were deemed a failure if they required any prescription medications.

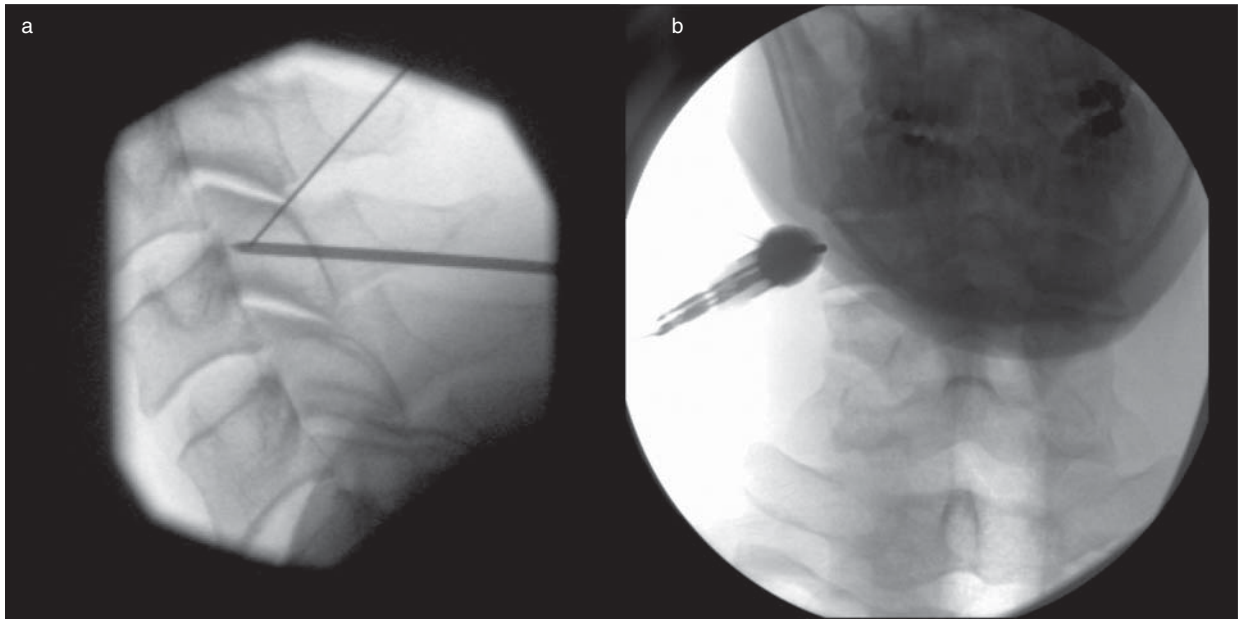

Figure 2 Images demonstrating electrode placement for sagittal pass, C5 radiofrequency neurotomy. (a) Lateral view. (b) Anteroposterior view.

The numbers and proportions of patients achieving various grades of outcome were tallied. The median duration (and interquartile range) of relief following the first RFN was calculated. The total duration of relief, allowing for repeat treatment, was graphed and its median was calculated, along with the median number and interquartile range of the number of treatments required to maintain this duration of relief.

Results

In the two practices, 104 consecutive patients were treated. Their presenting demographic features are summarized in Table 1, and their presenting clinical features in Table 2. The patients from the two practices were reasonably similar, demographically, although Practice B, which has a close association with a rehabilitation clinic, saw more patients who were manual workers and patients with work-related injuries than did Practice A. With respect to clinical features, Practice A treated patients with a longer duration of pain, but otherwise the two samples were similar (Table 2). Practice B performed RFN more often at greater than three segmental levels.

Table 1 Demographic features of patients treated with cervical radiofrequency neurotomy

Feature	Practice A	Practice B
Gender		
Male	13	34
Female	27	30
Age (years)		
Median	48	48
Interquartile range	41–57	40–56
Range	27–71	22–80
Occupation		
Tradesman	5	7
Manual worker	1	16
Retail	1	6
Professional	6	9
Manager	1	3
Retired	2	3
Domestic duties	4	1
Student	1	0
Clerical	2	3
Service industry	3	8
Not recorded	14	8
Work status		
Working full time	9	16
Working part time	4	11
Lesser duties	0	2
Not working	22	26
Not applicable	4	4
Not recorded	1	5
Injury		
Work-related	3	27
Sport	1	7
Motor vehicle accident	10	3
Whiplash	4	13
Other	3	12
None	0	1
Fall	8	0
Hit	6	0
Not recorded	5	1

Table 2 Presenting clinical features of patients treated with cervical radiofrequency neurotomy

Feature	Practice A	Practice B
Duration of pain (months)		
Median	65	24
Interquartile range	48–126	10–60
Range	12–240	5–300
Not recorded	2	0
Numerical pain rating (0–100)		
Median	60	55
Interquartile range	49–70	43–65
Nerves treated		
Third occipital nerve (C2–3)	17*	16*
C3,4	6	4
C4,5	5*	8
C5,6	13*	16*
C6,7	0	6
TON, C34	0	2
TON, C345	0	2
TON, C5,6,7	0	1
C3,4,5	0	2
C4,5,6	0	2
C4,5,6,7	0	2
C5,6,7	1	5

*Four patients were each treated for two, distinctive complaints mediated by different nerves: by the third occipital nerve and the C5,6 medial branches in one patient from Practice A and two patients from Practice B, and by the third occipital nerve and C4,5, in another patient from Practice A. TON = third occipital nerve.

The majority of patients had one symptomatic joint and the levels treated most commonly were C2–3 and C5–6; this provides corroboration of the study of Cooper et al. [15] who reported that C2–3 and C5–6 were the most commonly symptomatic levels.

One patient in Practice A had third occipital nerves treated on both sides. In Practice B, five patients underwent bilateral RFN: two at C4,5; one at C5,6; one at C5,6 on the right and C5,6,7 on the left; and one at C3,4,5 on the right and C3,4 on the left. All other patients, in both practices, were treated on one side only. Two patients in each of the practices were treated for separate pain complaints, one mediated by the third occipital nerve and the other by lower cervical medial branches. Their outcomes for each treatment have been recorded separately.

Of the patients for whom treatment was categorized as having failed, the largest subgroup were those who were

Table 3 Outcomes of patients treated with cervical radiofrequency neurotomy

Outcome		Practice A	Practice B
Failure	Outright; no relief	5	12
	Other pain	1	5
	Pain relieved; activities not restored	0	3
	Pain recurred, before 6 months	4	2
	Not complete relief of pain	0	4
	Lost to follow-up	0	0
	Not yet reached 6 months	1	0
Success	Complete relief of pain Activities restored	31*	40*
	No other health care Return to work	74% (61–87)	61% (49–72)

*Two patients in each practice each had their third occipital nerve and the C4,5 or C5,6 medial branches treated on separate occasions for separate, distinctive presenting complaints.

outright failures; they obtained no relief of their pain (Table 3). One patient had complete relief of pain, and had restored their activities of daily living, but they had only recently been treated and, therefore, had not reached the required 6 months duration of relief. They portend to become a successful outcome but, for present purposes, they were classified as not successes on technical grounds. Others were relieved of the pain for which they were treated, but still had pain from other sources that prevented complete recovery. Five patients were relieved of their pain and restored their activities, but the duration of relief did not last 6 months.

All other patients satisfied the criteria for successful outcome. They had complete relief of pain; they restored their activities of daily living; they required no other health care (apart from over-the-counter medications, if at all); and they returned to work, if applicable. Concessions applied to only five patients. In each practice, one patient reported 80% relief of pain and one reported 90% relief, and an additional patient in Practice B reported 85% relief, but all restored their activities of daily living, required no other health care, and returned to work. All other patients had complete relief of pain. One patient in Practice B was not relieved by a C5,6 RFN but was promptly treated with a supplementary RFN of C3,4 which provided complete relief of pain that endured for 24 months.

The success rate in Practice A was 74% and that in Practice B was 61%. These proportions are not significantly different statistically, and the weighted average of the two proportions is 66%. To some extent, the lower success rate in Practice B might be due to the operator having pursued treatment at multiple segmental levels, but most of the failures were after straightforward, single-level or two-level RFNs.

Among the patients with a successful outcome, some requested, and underwent, repeat treatment; others are awaiting repeat treatment, or have not requested it. Figure 1 shows the number of treatments undertaken to achieve and maintain complete relief of pain over an extended period.

The median duration of complete relief of pain following the first successful RFN was 17 months in Practice A (interquartile range: 12–29 months) and 20 months (12–30 months) in Practice B. After repeat treatment, Practice A achieved an aggregate of 959 months of complete relief of pain, in 31 patients, using 51 treatments, which amounts to a median duration of cumulative relief of 29 (16–42) months, and a median duration of 15 months per treatment or an average of 19 months complete relief per treatment. Practice B achieved an aggregate of 1,276 months of relief in 40 patients, using 65 treatments, which amounts to a median cumulative relief of 26 (18–45) months, with a median duration of 15 months per treatment or an average of 20 months per treatment. In both practices, some 60% of patients still had ongoing relief of pain at the time of follow-up. So, the figures earlier constitute worst-case values for the duration of relief achieved by RFN (Figure 3).

Discussion

The outcome measures used in the present study were unusual but deliberately so. The paradigm of cervical RFN maintains that if patients achieve complete relief of pain following controlled, diagnostic blocks, they should achieve complete relief following RFN. Therefore, complete relief of pain was adopted as the cardinal criterion for successful outcome. This had to be accompanied by complete restoration of activities in daily living, and no need for any other health care. These latter measures were used not only to corroborate the relief of pain, but also to indicate that cervical RFN is a restorative treatment.

Without any other intervention, cervical RFN completely relieves 66% of patients of their pain, and restores desired

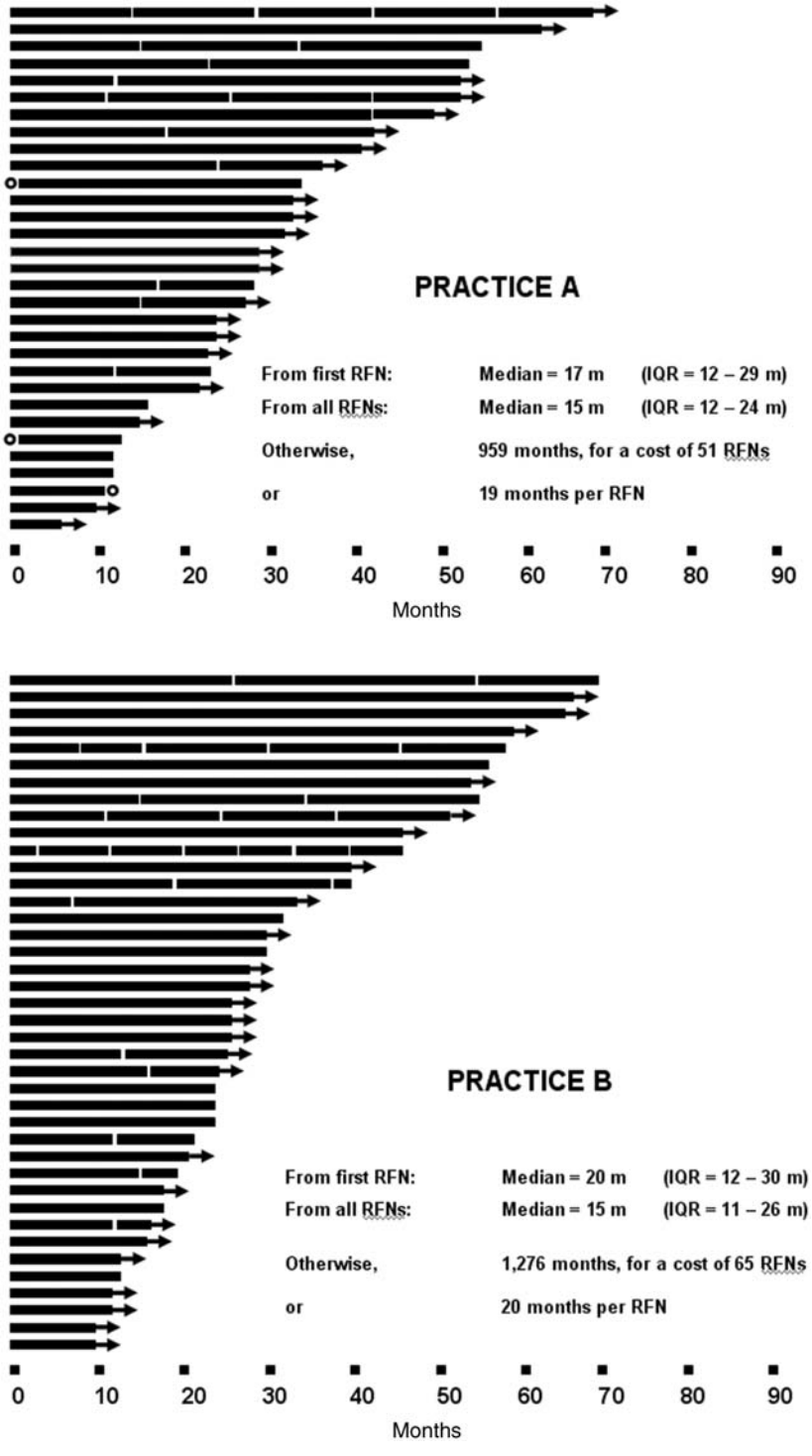

Figure 3 Duration of relief reported by patients treated with cervical radiofrequency neurotomy. Each line represents one patient. Each bar indicates the duration of relief following a single treatment. Interruptions indicate that relief ceased, followed by repeat treatment. Arrowheads indicate that complete relief was continuing at the time of follow-up. Circles indicate an RFN that did not relieve pain. The insets summarize the statistical parameters of each set of outcomes. IQR = interquartile range; RFN = radiofrequency neurotomy.

activities of daily living. A previous study has also shown that completely relieving patients of their pain will also relieve them of psychological distress [23].

Although a success rate of 61%, or even 74%, may appear modest, it does not pertain simply to "improvement" or achieving the minimal clinically important change. Explicitly it pertains to complete relief of pain, restoration of activities of daily living, no need for other health care, and return to work if applicable. No other treatment for chronic neck pain has ever achieved such outcomes, in any proportion of patients. Moreover, no other treatment has demonstrated such enduring effects: complete relief lasting over a year in most cases and beyond 3 years in many.

The patients in the present study were not "highly selected" in the sense that, prognostically, they were somehow destined to recover. They all had established, chronic neck pain, which does not have a natural history for recovery. The patients were selected on the basis of their responses to controlled, diagnostic blocks of the cervical medial branches. This does not define an exotic or uncommon subgroup of patients.

Several, independent, studies have shown that the representative prevalence of cervical zygapophysial joint pain among patients with chronic neck pain is 60% [24–30]. These studies indicate that cervical zygapophysial joint pain is the single most common basis for chronic neck pain. It is that majority subgroup that is eligible for cervical RFN.

The high proportion of injuries as a cause of pain in our practices may reflect uneven access to treatment in New Zealand, where radiofrequency neurotomy is funded by the Accident Compensation Corporation and not funded by some other insurers. Our figures may however reflect a high incidence of injury as a cause of cervical zygapophysial pain, as early studies of diagnostic cervical medial branch blocks [24–27] were predominantly carried out on patients with injuries.

The present study shows that when new practitioners are properly trained and follow rigorous protocols [1,2], they can achieve outcomes that are essentially identical to those achieved by academic practitioners who developed the procedure. Those protocols call for using RFN only in patients who obtain complete relief of pain following controlled diagnostic blocks; they abjure blocks without controls, and they abjure anything less than complete relief [2]. The protocols call for large electrodes, placed parallel to the target nerves, with several lesions made in order to encompass all possible variations in the location of the nerve, and in order to encompass a maximal length of nerve [1]; they abjure small electrodes, making single lesions, or placing the electrode perpendicular to the nerve. The present study and its predecessors [3,5–8] indicate that complete and enduring relief of pain can be achieved in over 60% of patients if these protocols are strictly followed. No published data indicate that the same outcomes can be achieved by any lesser or personalized variants of cervical RFN.

Of some concern is the fact that cervical RFN is not universally successful. The failure of some 30% of patients to respond is compatible with the limited specificity of cervical medial branch blocks (65%) [16,31,32]. False-positive responses to diagnostic blocks probably account for most of the failure of cervical RFN. Two options arise.

A purist approach would be to call for placebo-controlled, diagnostic blocks. These might reduce the false-positive responses but they will not necessarily eliminate them, for there is always a possibility of patients "surviving" a placebo challenge, by having a false-positive response to local anesthetic and a true negative response to placebo.

A pragmatic resolution is to continue to use controlled diagnostic blocks and entertain a possible failure rate of 30% for RFN. Under these conditions, the measure of cervical RFN is not that it falls short of a 100% success rate, but that it is successful in two-thirds of patients, for whom there is no other known treatment that can abolish pain completely, restore activities of daily living, eliminate the need for other neck pain-related health care, and achieve return to work.

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