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**Long-term Follow-up of Patients Treated with Cervical
Radiofrequency Neurotomy for Chronic Neck Pain**
[Technique Assessments]

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Abstract

OBJECTIVE:: To determine the long-term efficacy of percutaneous radiofrequency medial branch neurotomy in the treatment of chronic neck pain.

METHODS:: Between 1991 and 1996, radiofrequency neurotomy was performed in 28 patients diagnosed as having cervical zygapophysial joint pain on the basis of controlled diagnostic blocks. The procedure was repeated in patients whose pain recurred. Outcome measures were the proportion of patients who responded to the initial procedure and the duration of relief subsequently obtained. Outcome was correlated with the operator performing the procedure, the type of electrode used, litigation status, and the type of diagnostic blocks used to establish the diagnosis.

RESULTS:: Complete relief of pain was obtained in 71% of patients after an initial procedure. No patient who failed to respond to a first procedure responded to a repeat procedure, but if pain returned after a successful initial procedure, relief could be reinstated by a repeat procedure. The median duration of relief after a first procedure was 219 days when failures are included but 422 days when only successful cases are considered. The median duration of relief after repeat procedures was at least 219 days; several patients had ongoing relief at the time of follow-up. Outcome did not differ according to the operator, the type of electrode used, litigation status, or the type of diagnostic block used.

CONCLUSION:: Radiofrequency neurotomy provides clinically significant and satisfying periods of freedom from pain, and its effects can be reinstated if pain recurs.

The Quebec Task Force on Whiplash-Associated Disorders (24) reported that there are no valid diagnostic techniques for chronic neck pain and no proven therapy. That report, however, was based on a literature search that terminated in 1993. Research since that date has demonstrated that there is a diagnosable cause of neck pain that follows whiplash, and that this can be treated neurosurgically.

Using comparative local anesthetic blocks (2, 4) or diagnostic placebo-controlled blocks (14, 15), epidemiologic studies have shown that zygapophysial joint pain accounts for some 50% of patients with chronic neck pain after whiplash (4, 15). Treatment of cervical zygapophysial joint pain with intra-articular injections of corticosteroids proved to be ineffective (3), but percutaneous radiofrequency cervical medial branch neurotomy was reported as offering promise. A review of the published literature (9, 20-23, 25) revealed problems with patient selection and technical errors (13), but correction of these errors provided a procedure that apparently could achieve profound and lasting relief of pain. A pilot study found that in patients with pain arising from joints below the C2-C3 level, the proportion of patients who obtained relief was sufficient to justify a larger trial.

A randomized, double-blind, controlled trial was then performed; it showed clearly that the results of cervical radiofrequency neurotomy could not be ascribed to a placebo effect (16). Under strict double-blind conditions, the median duration of complete pain relief was found to be 8 days in 12 patients treated with sham surgery but 263 days in 12 patients with active lesions. This trial was criticized for having insufficient numbers from which to extrapolate and generalize (11). However, the trial was not designed to demonstrate the durability of the effect of radiofrequency neurotomy; it was expressly designed to determine whether the effect was that of a placebo. For that purpose, the trial had adequate numbers and adequate statistical power. Determination of the generalizability and durability of the results requires a different type of study.

In the present study, we report the results of a long-term follow-up of patients who had chronic neck pain arising from zygapophysial joints and were treated with percutaneous radiofrequency neurotomy of the cervical medial branches. The study addressed not only the duration of pain relief but also its relationship to the type of diagnostic blocks used, the type of electrode used, and litigation status.

PATIENTS AND METHODS

The patients reported in this study underwent percutaneous radiofrequency neurotomy between March 1991 and October 1996. Eleven patients reported previously in our pilot study (13), 14 participants in the controlled trial (16), and 3 patients treated in the period since that trial were included in the study. All 28 patients had neck pain of more than 12 months' duration (median, 69 mo; interquartile range, 50–106 mo). Twenty-seven patients attributed their pain to a motor vehicle accident; the other patient attributed neck pain to work practices over a prolonged period. Litigation was neither an inclusion nor an exclusion criterion.

Diagnostic phase

The diagnosis of cervical zygapophysial joint pain was based on either comparative local anesthetic blocks (2, 4, 14) or placebo-controlled blocks (14, 15). For comparative blocks, the medial branches innervating the target joint were anesthetized on two separate occasions, with two different local anesthetics (lignocaine 2% and bupivacaine 0.5%), administered in random order under double-blind conditions. The criterion for a positive diagnosis was that the patient obtained complete relief on both occasions and that longer-lasting relief was produced when the longer-acting agent was used.

For placebo-controlled blocks, each patient underwent blocks on three occasions. On the first occasion, one of the two local anesthetic agents was used to establish that pain from the target joint could ostensibly be relieved. For the second block, either normal saline or the second local anesthetic was administered in a randomized fashion, under double-blind conditions. For the third block, the remaining agent was used. The criterion for a positive diagnosis was that the patient obtained complete relief from pain, irrespective of duration, whenever a local anesthetic was used but no relief when normal saline was used.

A positive response to either comparative or placebo-controlled blocks was used to satisfy eligibility for radiofrequency neurotomy.

Logistically, comparative blocks are easier to implement in conventional practice and, therefore, are likely to be preferred and used by operators unable to perform placebo-controlled blocks. However, when compared with placebo-controlled blocks, comparative blocks have a sensitivity of only 54%, but their false-positive rate is very low (14). Therefore, comparative blocks will not detect all eligible cases, but a diagnosis based on comparative blocks is unlikely to be wrong. It has not been shown, however, that comparative blocks have the same predictive validity as placebo-controlled blocks. For that reason, in the present study, the outcomes of patients diagnosed using placebo-controlled blocks and those diagnosed by comparative blocks were compared.

A putatively symptomatic joint was selected, according to the method described by Dwyer et al. (8), based on the distribution of the patient's pain. Diagnostic blocks were commenced at the selected segmental level. In patients with bilateral pain, blocks were undertaken on the more painful side. If the first block relieved the patient's pain, control blocks of the same joint were undertaken. If the first block failed to relieve the patient's pain, a new joint at a different segmental level was selected, and blocks were commenced at that level (usually the level above or below the initially selected level). This process was reiterated either until a diagnostic response was obtained or until all levels that might reasonably be the source of the patient's pain had been exhausted (usually C4–C5, C5–C6, and C6–C7 in patients with lower neck pain, and C2–C3, C3–C4, and C4–C5 in patients with upper neck pain).

Therapeutic phase

The technical aspects of cervical medial branch neurotomy have been detailed elsewhere (6, 13, 16, 17). In essence, the procedure involves placing a radiofrequency electrode parallel to the medial branches that innervate the painful joint (5) (Fig. 1). To maximize the length of nerve coagulated, each of two approaches is used. A posterior approach, 30 degrees oblique to the sagittal plane, is used to reach the target nerve over the anterolateral aspect of the articular pillar (Fig. 2). A posterior parasagittal approach is used to reach the nerve over the lateral aspect of the articular pillar (Figs. 1–3).

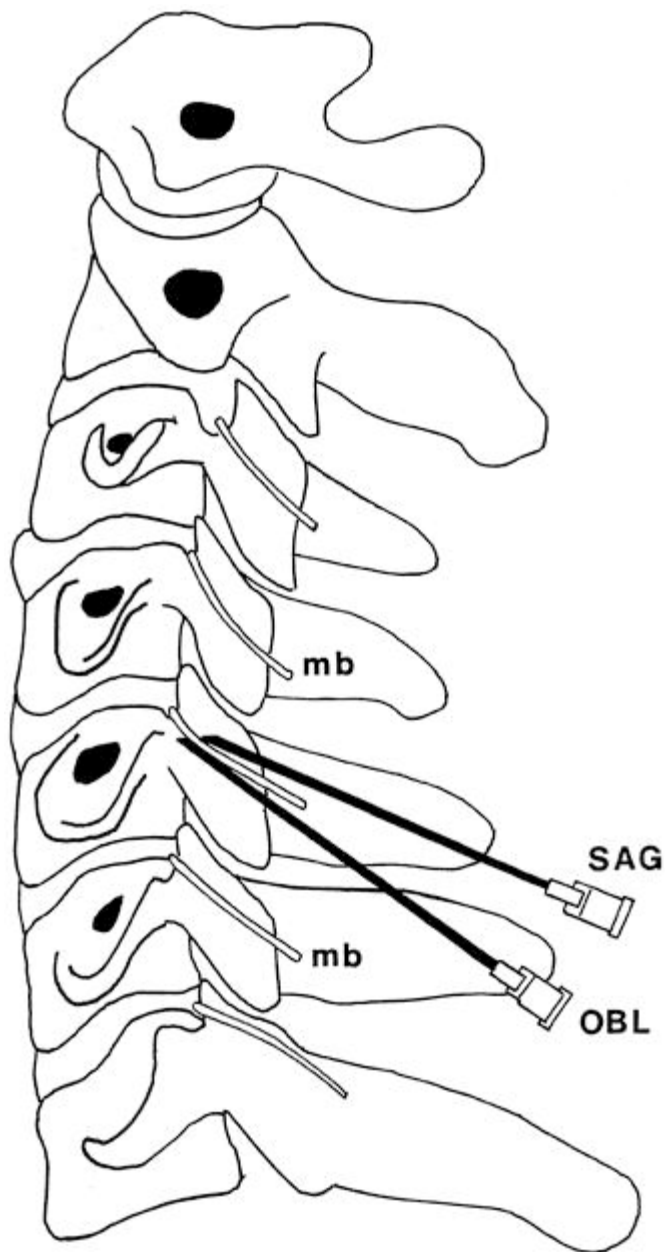


FIGURE 1. Sketch of a lateral view of the cervical spine showing the course of the medial branches of the cervical dorsal rami (*mb*) and placement of electrodes along a sagittal path (*SAG*) and an oblique path (*OBL*) to coagulate the target nerve.

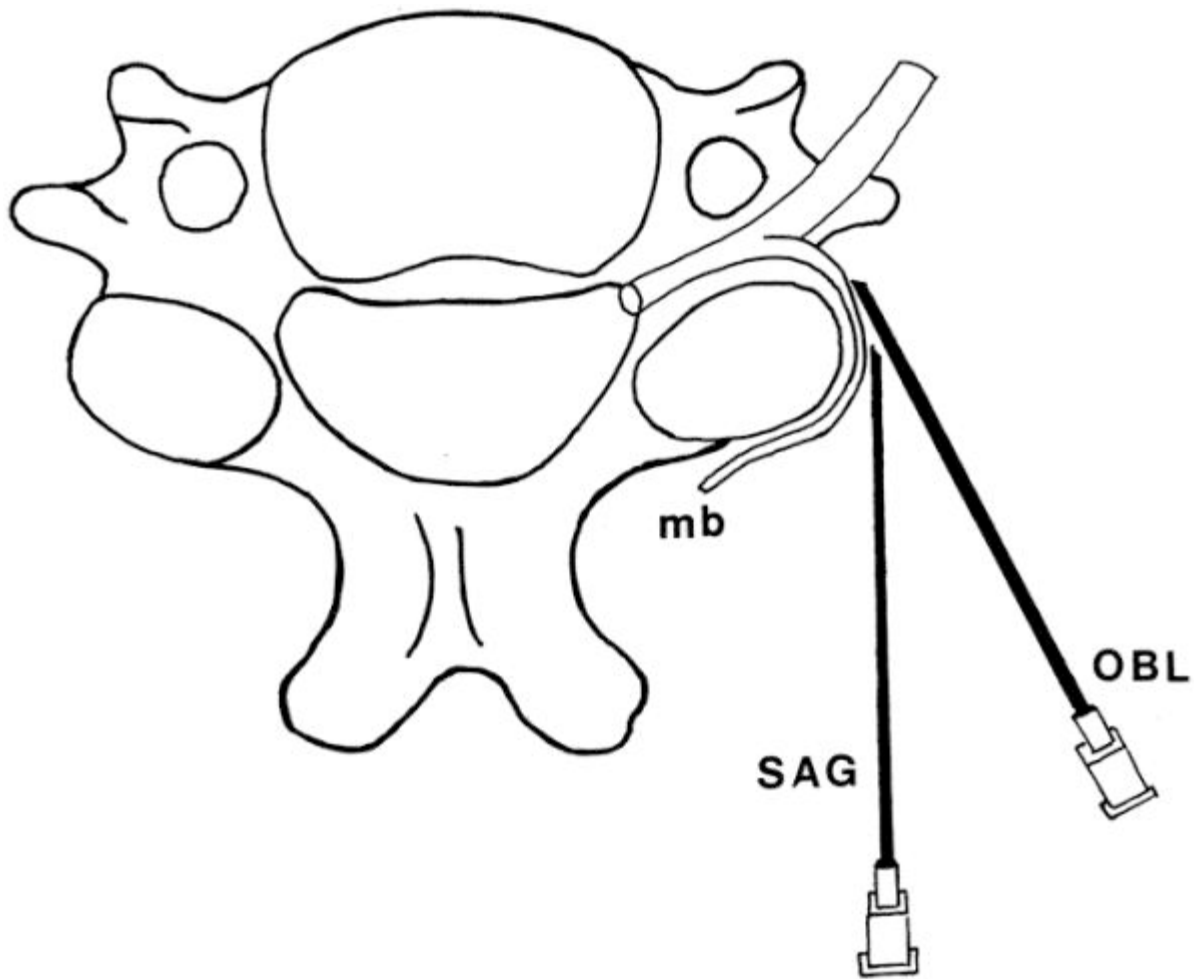


FIGURE 2. Sketch of top view of a cervical vertebra, showing the course of the medial branch (*mb*) and the orientation of electrodes placed along a sagittal path (*SAG*) and an oblique path (*OBL*) to coagulate the nerve.



FIGURE 3. Lateral radiograph showing an electrode in position for the performance of radiofrequency neurotomy of the medial branch of a C5 dorsal ramus. Lesions would be made at the site illustrated and at one electrode-width above and below.

To accommodate known possible variations in the course of the target nerve, several lesions are made during each approach. In patients with large articular processes, a lesion is placed opposite the cephalocaudal midpoint of the articular pillar, and additional lesions are placed above and below this point. In patients with smaller articular pillars, lesions are placed just above and below the midpoint. The criteria for placing lesions were that the lesions had to be located at the presumed and possible locations of the target nerve and that the lesions had to be contiguous, lest the nerve escape coagulation. For lesions to be contiguous, they had to be placed such that the electrode in one position was not more than one electrode-diameter away from where it was in a previous placement. This criterion applied because it has been shown that the maximum effective radius of a radiofrequency lesion is not reliably more than one electrode diameter (6, 12).

All operations were performed under generous local anesthesia. The target nerve was anesthetized over the anterolateral aspect of its

articular pillar with 0.5% bupivacaine. If, during the course of the operation, the patient felt any discomfort, supplementary anesthesia was administered.

Some patients were treated using the Sluijter-Mehta SMK-C10 cannula (22 gauge; length, 10 cm; exposed tip, 4 mm; Radionics, Burlington, MA). In others, the Ray RRE-TM thermistor electrode (diameter, 1.6 mm; length, 10 cm; exposed tip, 6 mm; Radionics) was used. The larger electrode generates larger lesions (12) and was therefore used with the expectation that the risk of missing the target nerve would be reduced. With either electrode, lesions were made by raising the temperature measured at the tip to 80°C and maintaining that temperature for 90 seconds.

During the study, one operator (SML) performed 30 of the procedures, and another operator (NB) performed 16 procedures. Two other operators performed three and five procedures in the course of training in the technique. To test whether the outcome was operator dependent, results were tabulated according to operator and the duration of relief obtained.

Assessment

Before the operation, baseline measures were obtained concerning the distribution and severity of each patient's pain and the associated disability. Severity was recorded on a visual analog scale (10) and with the McGill Pain Questionnaire (18, 19). For the determination of disability, patients nominated four activities of daily living that were eliminated or impeded by their pain and which they would most want restored if their pain could be relieved.

Patients were discharged on the afternoon after their operation. Telephone contact was made 3 and 10 days afterward to monitor postoperative pain and any side effects. Progress was recorded in a formal interview at follow-up after 3 and 12 months or when pain returned. The duration of pain relief was the principal outcome measure. For patients to be considered to have had successful outcomes, they had to obtain complete relief of their pain for a period of at least 90 days. The total duration of pain relief was defined as the period until the patient judged that pain had returned to 50% of the preoperative level (a previous study has shown that patients are able to gauge 50% return of pain quite accurately). Subjective pain relief had to be corroborated by a score of less than 5 mm on a 100-mm visual analog scale and a total word count of fewer than four on the

McGill Pain Questionnaire. Moreover, the patient had to have restoration of the four previously nominated activities of daily living, provided that there was no other cause for disability. Repeat operations were offered once pain had returned to the preoperative level.

RESULTS

Between March 1991 and October 1996, 28 patients underwent cervical medial branch neurotomy at a level between C3–C4 and C6–C7. Their demographic and clinical features are summarized in [Table 1](#) . Fourteen patients had insurance claims still subject to litigation, and 14 did not. Of these, 11 had settled a claim, and 3 patients had never entered into litigation. Eleven were diagnosed as having cervical zygapophysial joint pain by comparative blocks and 17 by placebo-controlled blocks. In most cases, the initial operation was performed with the SMK electrode (23 SMK; 5 Ray), and most repeat operations were performed using the Ray electrode (23 Ray; 3 SMK).

TABLE 1. Demographic and Clinical Features of Patients Undergoing Cervical Medial Branch Neurotomy^a

| Patient No. | Sex/Age (yr) | Pain | | Block | Litigation | First Operation | |
|-------------|--------------|--------------|--------|-------------|------------|-----------------|------------------------|
| | | Duration (d) | Level | | | Date | Duration of Relief (d) |
| 1 | M/34 | 2555 | C5,6 | Comparative | Pending | 3/1991 | 1095 |
| 2 | M/37 | 2344 | C6,7 | Comparative | None | 12/1991 | 0 |
| 3 | M/44 | 1727 | C5,6 | Comparative | Pending | 4/1992 | 190 |
| 4 | M/45 | 5213 | C5,6,7 | Comparative | None | 5/1992 | 413 |
| 5 | M/58 | 1062 | C5,6 | Comparative | Pending | 5/1992 | 495 |
| 6 | F/25 | 1726 | C5,6 | Comparative | Pending | 6/1992 | 30 |
| 7 | F/57 | 3650 | C5,6 | Comparative | None | 7/1992 | 0 |
| 8 | M/42 | 622 | C5,6 | Comparative | Pending | 7/1992 | 10 |
| 9 | F/25 | 1498 | C5,6 | Comparative | None | 10/1993 | 5 |
| 10 | M/51 | 2233 | C5,6 | Comparative | Pending | 1/1994 | 227 |
| 11 | F/36 | 1492 | C3,4 | Placebo | Pending | 2/1994 | 102 |
| 12 | M/34 | 4322 | C4,5 | Placebo | None | 4/1994 | 230 |
| 13 | M/33 | 1216 | C5,6 | Placebo | None | 4/1994 | 1071+ |
| 14 | M/44 | 3013 | C6,7 | Placebo | Pending | 6/1994 | 301 |
| 15 | M/53 | 9404 | C5,6 | Placebo | Pending | 7/1994 | 807 |
| 16 | F/36 | 1655 | C5,6 | Placebo | None | 8/1994 | 430 |
| 17 | M/68 | 2976 | C3,4 | Placebo | Pending | 9/1994 | 60 |
| 18 | F/58 | 3993 | C5,6 | Placebo | None | 10/1994 | 0 |
| 19 | M/49 | 2107 | C5,6 | Placebo | None | 11/1994 | 0 |
| 20 | F/38 | 1776 | C5,6 | Placebo | Pending | 3/1995 | 210 |
| 21 | F/65 | 9981 | C5,6 | Placebo | None | 3/1995 | 761+ |
| 22 | F/46 | 1715 | C3,4 | Placebo | None | 4/1995 | 485 |
| 23 | F/45 | 2050 | C4,5 | Placebo | None | 4/1995 | 719+ |
| 24 | F/43 | 387 | C3,4 | Placebo | Pending | 4/1995 | 0 |
| 25 | M/63 | 2370 | C3,4 | Placebo | None | 7/1995 | 622+ |
| 26 | F/33 | 1112 | C4,5,6 | Placebo | Pending | 8/1995 | 138 |
| 27 | F/30 | 3227 | C3,4 | Comparative | None | 8/1995 | 267 |
| 28 | F/39 | 1374 | C4,5 | Placebo | Pending | 12/1995 | 0 |

^a Age, age at operation; duration, time since onset of pain until first operation; level, segmental level(s) at which neurotomy was performed; block, type of diagnostic block initially used to establish diagnosis; comparative, comparative local anesthetic blocks; placebo, placebo-controlled blocks; +, continuing relief at time of review.

Table 1. Demographic and Clinical Features of Patients Undergoing Cervical Medial Branch Neurotomy^{aa} Age, age at operation; duration, time since onset of pain until first operation; level, segmental level(s) at which neurotomy was performed; block, type of diagnostic block initially used to establish diagnosis; comparative, comparative local anesthetic blocks; placebo, placebo-controlled blocks; +, continuing relief at time of review.

The initial procedure provided greater than 90 days of pain relief in 18 of the 28 patients. The median duration of relief for the 28 procedures was 218.5 days (interquartile range, 6–492 d). The median duration of relief for the 18 successful procedures was 421.5 days (interquartile range, 223–730 d). The reason for failure was apparent in four patients. In one, the equipment failed intraoperatively. Osteophytes prevented appropriate electrode placement in one patient. A third patient was found to have a second pain source, which was unmasked

when the dominant pain was treated. A fourth patient, whose diagnosis was made with comparative blocks, was later found to respond to a saline injection at another level.

Of the 10 patients who failed to obtain relief after their first operation, six underwent repeat procedures. Only two of these six patients obtained relief. Each of these patients subsequently underwent two successful procedures. In no case in which the initial procedure provided less than 30 days of pain relief was the repeat a success.

Of the 28 patients treated, 20 (71%) obtained complete relief for clinically satisfying periods, after one or more attempts at operation (Fig. 4). Of these 20 patients, 11 underwent repeat neurotomy when their pain recurred. Moreover, 4 patients underwent multiple repeat procedures whenever their pain recurred. Each time the procedure was repeated, their pain was relieved for at least 90 days. Repeated procedures, therefore, provided them with enduring relief over months and years (Fig. 4). The range of cumulative duration of relief was 14 months as a result of four procedures to 5.4 years as a result of two procedures. The median duration of relief per procedure in this group was 218.5 days (interquartile range, 144–478 days).

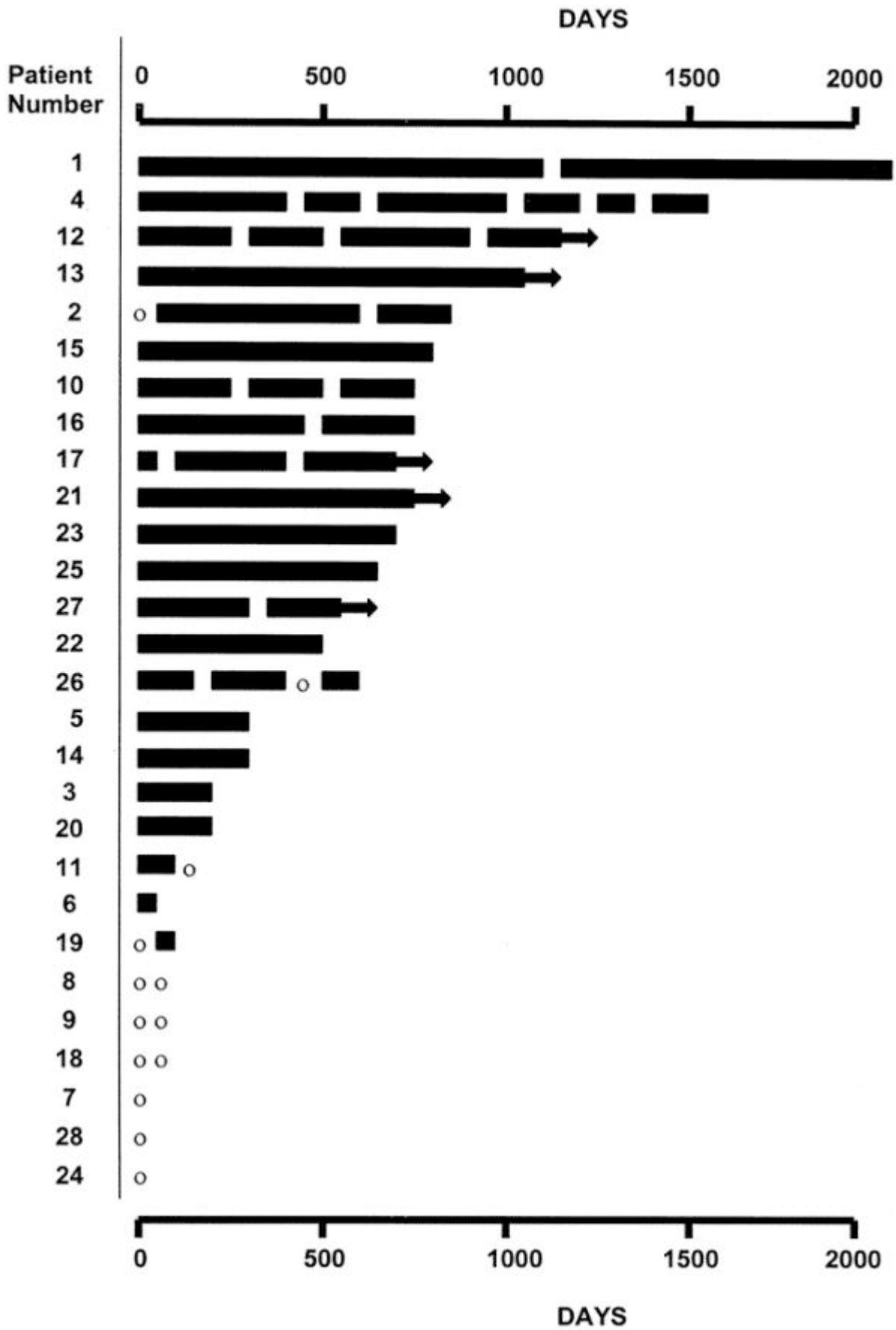


FIGURE 4. Bar graph illustrating the number of patients who obtained relief from cervical radiofrequency medial branch neurotomy, the number of procedures performed on each patient, and the duration of relief after each procedure. *Filled bars*, complete relief of pain; *interruptions*, cessation of relief; *arrows*, ongoing relief; *o*, no relief.

Repeat operations were not performed in the other nine patients. In four cases, pain relief was ongoing at the time of analysis. In two patients pain had reached 50% of the preoperative level but was still of insufficient severity to justify repeat treatment. One patient was attempting to become pregnant. One patient underwent cervical fusion, and one moved out of state and was lost to follow-up.

With respect to initial success rate, there was no statistically significant difference when operations were performed with the SMK electrode or the Ray electrode, in patients with litigation, or when placebo-controlled blocks were used to establish the diagnosis instead of comparative local anesthetic blocks. With respect to duration of relief, there was no statistically significant difference between patients with litigation and those with no litigation pending, or between patients diagnosed by placebo-controlled blocks and those diagnosed by comparative blocks. The only statistically significant difference encountered was that, overall, in those patients whose pain was relieved, the duration of relief was greater in patients treated with the SMK electrode; but this difference appeared to be spurious. It was attributable to the relatively greater duration of relief obtained in those patients treated by the senior operator (SML) when using the SMK electrode, but her results were not significantly greater than those obtained by the next most frequent operator (NB) using either the SMK or the Ray electrode.

DISCUSSION

The results of this study demonstrate that the relief of neck pain obtained by percutaneous radiofrequency neurotomy can be clinically satisfying but of limited duration. Patients can expect between 223 and 730 days of complete relief after an initial procedure and between 144 and 478 days of relief after repeat procedures.

Not all patients diagnosed as having cervical zygapophysial joint pain will respond to surgery. The initial success rate is only 70%. However, the data available from this study do not provide a means of predicting

which cases are more likely to succeed. Whether patients are selected by placebo-controlled or comparative diagnostic blocks made no difference with regard to outcome. Litigation status did not affect outcome.

In principle, technical problems may affect the efficacy of the procedure. An inaccuracy of 1 mm in electrode placement is sufficient for the target nerve to escape adequate coagulation. Theoretically, this risk should be reduced by using the Ray electrode (and thereby generating larger lesions). The present results do not support this contention. Although a greater proportion of patients obtained initial relief when the Ray electrode was used, the difference was not significant. Results obtained with the Ray electrode were not superior to those obtained with the SMK electrode. This argues against any superiority of the larger electrode.

What is noteworthy is that in no case in which the first operation failed to provide at least 30 days of relief did a repeat operation achieve relief. This could indicate that the initial diagnosis was false, despite controlled blocks having been used, but operative aspects cannot be discounted. Variations in the location of the target nerve and failure to place lesions meticulously could account for failure to coagulate the nerve in the first instance, and under those circumstances, repeat procedures could fail if they were executed in the same way as the first procedure. These considerations suggest that if neurotomy is repeated after an initial failure, close attention should be paid to possible technical flaws in the initial procedure, which should be corrected during the repeat procedure. On the other hand, if radiofrequency neurotomy provides lasting relief on the first occasion, it is very likely to reinstate relief if repeated when pain recurs.

The relief obtained from radiofrequency medial branch neurotomy should not be expected to be permanent. Coagulation denatures the proteins of the peripheral nerve and thereby prevents nociceptive conduction along it (26), but as long as the ganglion of that nerve remains intact, the nerve will recover. Once the nerve heals, conduction is reestablished, and pain recurs. Destruction of the ganglion is not recommended, because it would incur the risk of side effects and complications of deafferentation in the territory of the entire spinal nerve. Repetition of medial branch neurotomy to reinstate relief is therefore a more attractive prospect than the possible side effects of ganglionolysis.

Although pain relief can be reinstated by repeat radiofrequency neurotomy, it is unknown how many times the operation can be repeated and whether the duration of relief will change. In the present study, the median duration of relief after repeat procedures was 218 days at the time of data collection, but in several cases, relief was ongoing, suggesting that the true duration of relief would be higher.

Concerns that radiofrequency neurotomy might cause Charcot's arthropathy (7) are not valid. Charcot's arthropathy occurs in weight-bearing joints of limbs in which all deep tissues are anesthetic. Moreover, a neurovascular mechanism rather than unrecognized trauma has been implicated (1). Cervical medial branch neurotomy denervates only one joint of three in a spinal segment and little more than 20% of the muscles acting on that segment. Therefore, the segment does not remain unprotected. However, those considerations caution against performing the procedure indiscriminately bilaterally and at multiple levels. As more nerves are coagulated, more of the cervical musculature will be denervated, increasing the risk of cervical instability and ataxia. At present, our recommendations are to operate at one level, in the first instance, and to test patients with prognostic blocks before proceeding to neurotomy at additional levels.

It is understandable that a procedure that takes up to 3 hours to perform is unlikely to be attractive to some practitioners (11). However, radiofrequency neurotomy is the only treatment for neck pain that has survived a randomized, double-blind, controlled trial and which achieves complete relief of pain; it is the only available definitive therapy for cervical zygapophysial joint pain. Against that background, the investment of therapeutic time is worth the result achieved. Radiofrequency neurotomy is a valid and profoundly effective option for patients with otherwise intractable chronic neck pain.

There is scope to improve the procedure in the future by lessening the number of lesions required to achieve the same result and otherwise expediting the procedure. However, modifications to the procedure should not be made presumptively; they should be evaluated. To that end, the present study constitutes an initial benchmark. If a modified, shorter procedure can be shown to achieve the same long-term success, it can replace the present arduous procedure. Until such evidence emerges, untested modifications or shortcuts should not be accepted.

ACKNOWLEDGMENTS

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Shortly before this article was accepted for publication, the senior author, Dr. Greg McDonald, died at the age of 35, after a short battle with cancer. His colleagues and patients wish to honor his memory and the efforts he made, in so brief an emerging career, to bring relief to patients with chronic pain.

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COMMENTS

The methodology used by the authors to prove the effectiveness of their procedure on cervical zygapophysial joint pain below C2–C3 is meritorious and convincing. Practitioners involved in pain surgery—provided that they adopt the rigorous standards of the Newcastle team—should have this technique in their armamentarium. Before being accepted for operation, patients with cervical pain should undergo careful clinical and radiological assessment by experienced and prudent specialists. This procedure should be reserved for zygapophysial joint pain with limited extension and at well-specified level(s), which are not so easy to determine, even with local anesthetic block(s).

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Over the past 10 to 15 years, Bodguk, Lord, Barnsley, and a number of co-investigators have systematically evaluated the causes of previously unexplained cervical pain syndromes and their potential

treatments. The authors have previously demonstrated that placebo-controlled diagnostic blockade of specific cervical segments can reliably identify cervical pain generators. Many patients with chronic cervical complaints are found to have the cervical zygapophyseal joints as the major generators of the pain. After acceleration/deceleration injury, C2–C3 zygapophyseal joint disruption has been demonstrated to be a common pain generator. Provocative blockade of the cervical discs also demonstrates that they are another common source of axial pain. By using comparative and placebo-controlled blocks, Bodguk et al. have demonstrated that comparative blocks have a low sensitivity but high selectivity; thus, false-positives are rare. This means that the patients selected for procedures without placebo-controlled blocks are unlikely to be wrongly selected, but many patients who could potentially benefit from any proposed procedure might be missed.

Based upon the identification of patients with apparent zygapophyseal joint pain by placebo and comparative blockade, the authors have attempted to denervate these joints by radiofrequency techniques that have long been used successfully in the lumbar spine. Their data demonstrate that the majority of patients identified by blockade can sustain beneficial effects from percutaneous denervation for 6 months or longer. Furthermore, when pain recurs, repeat denervation is again satisfactory. When pain relief is coupled with a vigorous neck-strengthening exercise program, it is certainly conceivable that prolonged relief will occur, but that remains to be demonstrated.

The alternative to this simple percutaneous technique is cervical fusion, upper cervical ganglionectomy, or both. Our own investigation of fusion in these patients (manuscript in preparation) suggests that a long-term success rate of 90% can be achieved by fusion in appropriately selected patients. However, these are formidable operations, and the potential to offer patients relief with simpler, safe techniques is very attractive. My own current practice is to identify patients with comparative blocks and offer denervation to those who achieve pain relief with cervical zygapophyseal joint blockade. If the denervation fails, these patients are offered posterior cervical fusion, and the results have been excellent. The authors have persevered to demonstrate the origins of pain in a substantial number of patients who previously were undiagnosable. The radiofrequency technique that they have used is not permanent in the majority of patients but offers an alternative to a major surgical procedure that will be useful for many patients.

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The authors of this article, specialists in pain management from Australia, present their results with chronic neck pain treatment in 28 patients. They used a percutaneous technique of radiofrequency thermal lesions of the medial branch of the dorsal ramus of the cervical nerve, and the selection of the patients was based on their response to multiple diagnostic blocks. The study showed that more than 70% of patients (20 of 28) were relieved of their pain by one or more percutaneous neurotomies, and this pain relief lasted, on average, 7 months per procedure.

Almost all patients developed their pain after motor vehicle accidents, and half of the patients were involved in an ongoing litigation process. The association of the pain with cervical zygapophysial joints was tested by diagnostic blocks, and only those patients who passed a trial of diagnostic blocks with either different local anesthetic agents (shorter- and longer-acting) or placebo-controlled blocks were selected for the neurotomy procedure. The diagnostic blocks also served for final localization of the painful joint. The procedure itself was performed by different physicians and using different electrodes. The results were subsequently compared to determine the value of different block techniques, the individual skills of each operator, or the specific electrode for inducing lesions. The importance of ongoing litigation on the length of the pain relief was also evaluated.

Based on the results of this study, it seems that the technique of percutaneous radiofrequency neurotomy of the medial branch may be considered an effective means of the pain relief in a selected group of patients. None of the variables affected the outcome significantly, although the larger electrode seemed to produce longer pain relief.

Several further conclusions can be reached. First of all, if uneventful neurotomy did not produce pain relief, the repeat procedure was unlikely to be of benefit to the patient. Second, all procedures had a limited duration of effect, and the duration of pain relief from repeat procedures was generally shorter than from the initial one. The absence of a permanent effect is not surprising, because a nerve lesion distal to its ganglion is almost always reversible, and the pain can recur soon after nerve regrowth. Third, the careful selection of operative candidates is probably the only explanation for this high degree of success. According to the study, placebo-controlled blocks are not essential for patient selection; however, pain relief after diagnostic block with local anesthetic in the vicinity of the

zygapophysial joint must be confirmed by either placebo injection or by injection of agents with different durations of action. The procedure requires a dedicated team and considerable operating room time; it usually requires about 3 hours to complete a single neurotomy procedure. This includes thorough local anesthesia and induction of two or three radiofrequency lesions at each articular level under careful fluoroscopic guidance. The last, but not the least important, conclusion stemming from the article is that patients should always be warned of postoperative pain and numbness (which may last up to 2 and 34 months, respectively), as well as possible cutaneous dysesthesias after the procedure. It is possible that as more neurosurgeons and pain specialists learn the technical details of this relatively noninvasive procedure, it will increasingly become a part of our surgical algorithm for the treatment of patients with chronic posttraumatic neck pain.

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This study is the third in a series of articles published in *Neurosurgery*. It is a well-planned study demonstrating the effectiveness of cervical radiofrequency neurotomy in the treatment of cervical zygapophysial joint pain, although the procedure was applied to a small number of patients. Local anesthetic blocks for testing seem to be indicated for the procedure, especially for patients with posttraumatic chronic pain. The authors demonstrate that selection of the correct anatomic target for destruction or testing with the technique described is more important than individual differences in manipulation from surgeon to surgeon. Lesions made parallel to the nerve axis instead of perpendicular are rational; thus, the conventional technique should be modified.

Selection of the type of electrode is one of the most important factors in clinical efficacy. The Sluiter-Mehta type of electrode (Radionics, Inc., Burlington, MA) may be the first-choice electrode for this procedure, whereas a thicker electrode, such as the RRE-TM manufactured by Ray, may be preferred if pain recurs. However, these observations were not based on controlled correlative studies. Therefore, further studies to evaluate differences between the effectiveness of different electrode types must be performed.

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Key words:: Cervical zygapophysial joint; Neck pain; Radiofrequency neurotomy; Treatment

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