

Efficacy and Validity of Radiofrequency Neurotomy for Chronic Lumbar Zygapophysial Joint Pain

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Study Design. A prospective audit.

Objective. To establish the efficacy of lumbar medial branch neurotomy under optimum conditions.

Summary of Background Data. Previous reports of the efficacy of lumbar medial branch neurotomy have been confounded by poor patient selection, inaccurate surgical technique, and inadequate assessment of outcome.

Methods. Fifteen patients with chronic low back pain whose pain was relieved by controlled, diagnostic medial branch blocks of the lumbar zygapophysial joints, underwent lumbar medial branch neurotomy. Before surgery, all were evaluated by visual analog scale and a variety of validated measures of pain, disability, and treatment satisfaction. Electromyography of the multifidus muscle was performed before and after surgery to ensure accuracy of the neurotomy. All outcome measures were repeated at 6 weeks, and 3, 6, and 12 months after surgery.

Results: Some 60% of the patients obtained at least 90% relief of pain at 12 months, and 87% obtained at least 60% relief. Relief was associated with denervation of the multifidus in those segments in which the medial branches had been coagulated. Prelesion electrical stimulation of the medial branch nerve with measurement of impedance was not associated with outcome.

Conclusions. Lumbar medial branch neurotomy is an effective means of reducing pain in patients carefully selected on the basis of controlled diagnostic blocks. Adequate coagulation of the target nerves can be achieved by carefully placing the electrode in correct position as judged radiologically. Electrical stimulation before lesioning is superfluous in assuring correct placement of the electrode. [Key words: back pain, lumbar zygapophysial joint, radiofrequency neurotomy, treatment] **Spine 2000; 25:1270–1277**

The prevalence of chronic lumbar zygapophysial joint pain ranges from 15% in younger patients¹⁵ to as high as 40% among elderly patients.¹⁷ The only proven treatment for this source of back pain is radiofrequency medial branch neurotomy. This operation is not a placebo. Van Kleef et al¹⁹ showed clearly, under double-blind controlled conditions, that patients treated with sham lesions did not obtain relief of pain. However, in patients

treated with active neurotomy, Van Kleef et al obtained only modest results. The mean pain scores of their patients decreased only slightly, from 5 on a 10-point scale to 3. A minority of their patients obtained complete pain relief.

The rationale of lumbar medial neurotomy is that patients with zygapophysial joint pain should obtain complete relief of their pain if the nerves that innervate the painful joint are coagulated. The failure of Van Kleef et al¹⁹ to secure this outcome consistently can be attributed to either of two factors: First, they selected their patients on the basis of single, diagnostic blocks, whereas controlled studies have shown that single blocks carry a false-positive rate of 38%.¹⁶ Therefore, patients without true zygapophysial joint pain may have been treated. Second, they placed the electrodes at an angle to the target nerve, whereas laboratory studies have shown that the electrode must lie parallel to the nerve if the nerve is to be maximally and optimally coagulated.³ Consequently, in some of their patients, Van Kleef et al may have failed to coagulate the target nerve adequately. In their study, adequate coagulation of the target nerves was not assessed with segmental electromyography of the multifidus.⁷

The current study was undertaken to document the efficacy of lumbar medial branch neurotomy under optimal conditions. Patients were selected on the basis of controlled diagnostic blocks to ensure that they had zygapophysial joint pain, and electrodes were placed meticulously to optimize coagulation of the target nerve. Furthermore, measures were taken to ensure that the nerve was indeed coagulated. The anatomy of the medial branches of the lumbar dorsal rami is such that each supplies a unique and accessible band of the multifidus muscle.^{4,11} Consequently, if the nerve is successfully coagulated, its respective band of multifidus should show signs of denervation. Accordingly, postoperative electromyography was performed to check for successful coagulation of the target nerves.

■ Methods

Although lumbar medial branch neurotomy could be applicable to other types of patients, stringent inclusion and exclusion criteria were applied in the current study to evaluate the efficacy of lumbar medial branch neurotomy in patients in whom comorbidity and psychosocial factors were not likely to confound the results. Accordingly, approval was obtained from the institutional review board for medical ethics at the East Texas Medical Center (Tyler, TX) to recruit and treat patients who met

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stringent selection criteria. To be eligible, patients had to be literate, be aged between 18 and 80, and have chronic low back pain of longer than 6 months' duration. They had to exhibit clinical features consistent with possible lumbar zygapophysial joint pain, such as pain and tenderness over not more than two lumbar segments bilaterally or three segments unilaterally; had to be able to understand and tolerate diagnostic blocks; and ultimately, had to be positive for lumbar zygapophysial joint pain after controlled diagnostic blocks. Exclusion criteria were pregnancy, prior low back surgery, concurrent cervical or thoracic pain or pain in these regions lasting longer than 2 weeks during the previous 6 months, compensable disability or work injury, ongoing litigation, prior treatment with radiofrequency neurotomy, and discogenic pain verified by controlled discography.

Four-hundred and sixty people responded to invitations to participate circulated throughout the local medical community and announced through local newspapers, radio, and television. Candidates were interviewed by telephone (by BH) to determine eligibility. After the interview, 138 patients remained potentially eligible, and a physical examination was performed by either of two investigators (AJ or PD). At this time, the patients completed a pain drawing and a Beck Depression Inventory.¹ If plain radiographs less than 1 year old were not available for review, anteroposterior and lateral plain radiographs were obtained. The physical examination was designed to detect or rule out secondary exclusion criteria, including sources of pain ostensibly not in the lumbar spine; pain in the hip or knee, even if lumbar pain was present; leg pain greater than back pain; obvious inappropriate pain behavior during physical examination; neurologic deficits; a positive straight leg raising result; any features of an upper motor neuron lesion; and gait abnormality not attributable to spinal pain. Additional exclusion criteria included spinal stenosis evident on prior computed tomogram (CT) or magnetic resonance image (MRI), spondylolysis or spondylolisthesis, a more than 75% narrowing of a disc space on plain radiographs, spondylarthropathy, presence of denervation in the multifidi established by electromyography, and a score higher than 20 on the Beck Depression Inventory.

After physical examination, 41 patients remained potentially eligible and proceeded to lumbar medial branch blocks. These were performed according to contemporary, validated methods,^{6,9} by the same investigator (PD). The segmental levels to be blocked were determined by the location of sites of maximum tenderness over putative painful joints, assessed under fluoroscopy. Patients underwent a modified comparative block protocol. At all times, the patients remained blind to the nature of the agent injected. For the first diagnostic block, 0.5 mL of 2% lidocaine was used to anesthetize each target nerve. In patients with tenderness ostensibly restricted to one joint, both nerves that innervate that joint were anesthetized. In patients with bilateral pain and tenderness, both joints at the same segment were anesthetized. In patients with more extensive pain, blocks were performed at consecutive levels up to a maximum of four nerves (three joints) in patients with unilateral pain, and three nerves bilaterally (two joints bilaterally) in patients with bilateral pain.

Once blocks were completed, patients were allowed to ambulate briefly and then to rest seated for 20 minutes, after which they were allowed to move *ad libitum* while remaining at the clinic. At 20 minutes after the procedure and hourly for 1 to 6 hours, the subjects rated their percentage relief of pain in

Table 1. The Demographic and Clinical Features of 15 Patients Who Underwent Lumbar Medial Branch Neurotomy

Feature	Number or Median [Range]
All patients	15
Males	10
Age	58 [28–79]
Females	5
Age	49 [36–65]
Duration of back pain	
1–2 years	2
2–5 years	5
>5 years	8
Duration of relief (hours)	
From lidocaine	4.4 [1.3–6.0]
From bupivacaine	4.9 [2–6.0]
Joints diagnosed	
L5–S1 unilateral	2
L4–5, L5–S1 unilateral	2
bilateral	10
L2–3, L3–4, L4–5 unilateral	1
Working	10
Retired or not working, but not because of pain	5

10% increments in a self-reported pain diary. Nineteen patients who reported less than 80% relief of pain were excluded from further investigation.

The 22 patients who reported at least 80% relief of pain for longer than 1 hour after the lidocaine blocks returned the following week for confirmatory blocks using 0.5% bupivacaine. In seven patients, the pain failed to respond to these blocks, and they were excluded from further study. Fifteen patients who obtained at least 80% relief of pain for longer than 2 hours, after the bupivacaine blocks, were offered radiofrequency neurotomy. Their clinical features are summarized in Table 1.

Before undergoing neurotomy and 1 week after the completion of diagnostic blocks, the patients completed baseline testing. This required completion of a cointervention inventory that included prescription analgesic medications, a visual analog scale (VAS) covering present pain and weekly average,⁸ a McGill pain questionnaire (MPQ),¹³ a Roland–Morris inventory,¹⁴ the SF-36 general health questionnaire,^{12,20} the North American Spine Society treatment expectations,⁵ isometric push and pull, lift tasks, a dynamic floor-to-waist lift, and isometric above-shoulder lifting tasks.² All functional assessments and written assessments were administered by one investigator (BH). Additionally, all patients underwent electromyography of the L2–L5 bands of multifidus to assess the presence or absence of denervation.^{7,18} All electromyograms were performed by one investigator (KP).

Radiofrequency medial neurotomy was performed with the patient prone on a fluoroscopy table. Intravenous, conscious sedation was used, if deemed necessary for patient comfort. The skin over the lumbar region was prepared in a sterile fashion. For each target nerve, a 22- or 25-gauge, 90-mm spinal needle was introduced as for a medial branch block, but instead

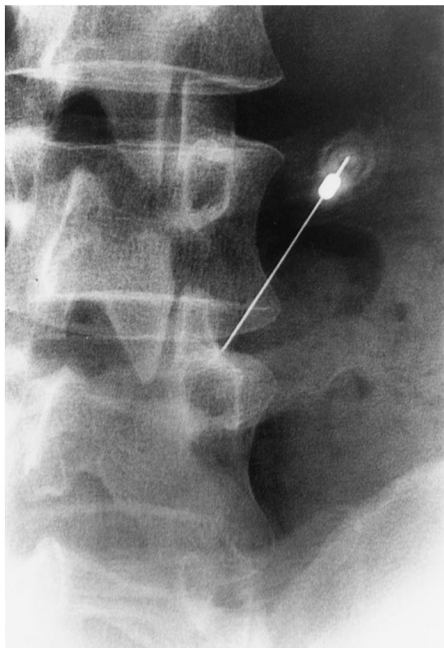


Figure 1. The lumbar spine view from below along a 20° caudad tilt with 15° of rotation, showing a block needle in place, pointing to and resting on the superior location of the L3 medial branch nerve at the L4 transverse process. A radiofrequency probe is aimed directly at the tip of the needle along the imaged groove between the transverse process and superior articular process.

of being positioned over the midpoint of the dorsal surface of the transverse point (or the ala of the sacrum, in the case of L5), the needle was positioned to access the nerve more proximally, at the superior edge of the transverse process (or the superior edge of the ala).⁶ Once placed, these needles were not used to anesthetize the target nerve but were used to guide the placement of the radiofrequency electrode.

For the introduction of the radiofrequency electrode, the C-arm of the fluoroscope was rotated laterally some 15° from a conventional posteroanterior orientation and angled caudad by approximately 20° to allow viewing of the target region somewhat from below, not unlike the pillar view in cervical spine radiography. This view at an angle from below shows the transverse process on edge, and demonstrates the groove between the transverse process and superior articular process along which the target nerve runs.³ When properly achieved, the view shows the tip of the guide needle resting on bone in the groove, pointing to the location of the nerve (Figure 1). For the L5 dorsal ramus, less transverse rotation of the C-arm was used so that the iliac crest did not obstruct the path of the electrode.

A puncture point was selected on the skin over the target groove, as seen on the declined view. This point was anesthetized with an intradermal injection of lidocaine and punctured with a 16-gauge needle, to more easily admit the radiofrequency electrode. The electrode used was a 16-gauge, Ray electrode (Radionics, Burlington, MA) with a 5-mm exposed, active tip. The electrode was introduced through the puncture point and the back muscles, toward the target groove, aiming initially to contact the caudal edge of the transverse process. Once contact was made, the electrode was readjusted to allow it to pass over the dorsal surface of the transverse process, passing snugly along the groove, so that medially it abutted against the root of the superior articular process, and ventrally

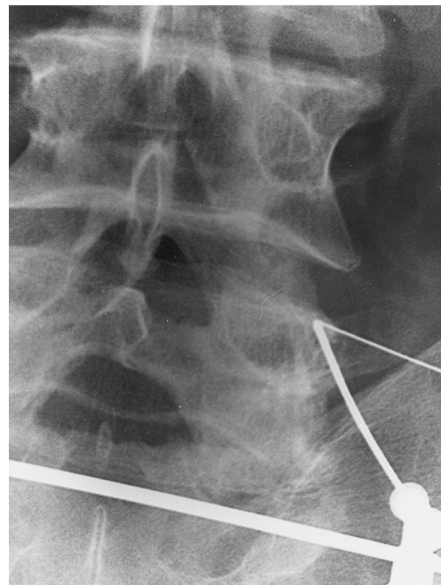


Figure 2. Posteroanterior radiograph of the lumbar spine showing a radiofrequency electrode correctly in place for coagulation of the L4 medial branch nerve as it crosses the root of the L5 transverse process. The block needle is also placed on the L4 medial branch nerve at its proximal position.

it glanced along the dorsal surface of the transverse process. The electrode was advanced until it was estimated to have reached the superior edge of the transverse process. Posteroanterior views were used to ensure that the electrode was placed snugly against the superior articular process (Figure 2). Lateral views were used to ensure that the tip of the electrode had not ventured beyond the transverse process toward the intervertebral foramen, and oblique views were used to check that the needle was oriented parallel to the estimated course of the target nerve (Figures 3 and 4). If the tip of the electrode projected within the silhouette of the foramen, it was withdrawn until its tip was immediately dorsal and caudal to the edge of the foramen, coinciding with the position of the tip of the block needle.

With a radiofrequency generator (Model 3FG-3C, Radionics), the electrode was used to stimulate the target nerve, with a pulse of 1-msec duration at 5 Hz. The physician performing the neurotomy (PD) noted the minimum voltage required to elicit a palpable and visible twitch of the multifidus at the segmental level treated. If this did not occur at 0.5 V or less, the electrode was repositioned until a twitch was elicited at this threshold, provided that the position of the electrode still appeared satisfactory on the three radiographic views. This usually required the electrode to be moved slightly more medially and occasionally dorsally—that is, up the wall of the superior articular process. If a multifidus twitch could not be elicited despite repositioning, the final placement of the electrode was based on the physician's judgment that it was in a satisfactory location, as seen in the three radiographic views. Once the electrode was in a satisfactory position, 0.75 mL of 2% lidocaine was injected through the guide needle to anesthetize the target nerve and the tissues surrounding the active tip of the electrode. After the anesthetic was administered, the block needle was withdrawn by a few centimeters so that it was not in contact with the electrode, and to prevent its acting as an antenna for the forthcoming radiofrequency current. Posteroanterior, oblique, and



Figure 3. Lateral radiograph of the lumbar spine showing a radiofrequency electrode correctly in place for coagulation of the L4 medial branch nerve as it crosses the root of the L5 transverse process. The block needle is also placed on the L4 medial branch nerve at its proximal position.

lateral films were obtained to record the final position of the electrode. Impedance was noted before lesioning.

A lesion was made by raising the temperature of the tip of the electrode to 85 C for 90 seconds. Thereafter, the electrode was withdrawn along its path for approximately 4–5 mm (*i.e.*, for the length of its exposed tip), and a second lesion was made using the same parameters (Figure 5). In this manner, the target nerve was coagulated 8–10 mm along its length, from where it first crossed the transverse process to where it passed under the mamilloaccessory ligament.

The same procedure was repeated at whatever segmental level was required. The nerves to be coagulated were defined by the previous response to diagnostic blocks. If diagnostic blocks of the L_n and L_{n+1} nerves had relieved the pain, those nerves

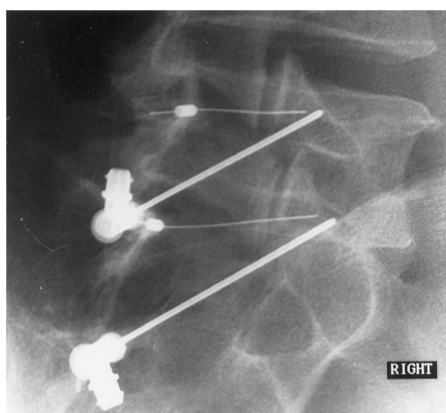


Figure 4. Oblique radiograph with radiofrequency needles at the proximal L4 medial branch and L5 dorsal ramus lesioning positions. Block needles have been withdrawn slightly.



Figure 5. Oblique radiograph with a radiofrequency needle at the distal L4 medial branch lesioning position.

were coagulated. If additional nerves had to be blocked to achieve complete pain relief, those nerves were also coagulated.

After neurotomy, patients were provided with 20 tablets of 5 mg hydrocodone (1–2 tablets every 8 hours) for relief of postoperative pain attributable to the trauma of the electrode insertion and the thermal lesion around the target nerve. Patients were allowed to be absent from work for the day of and day after the procedure.

The first follow-up was conducted 6 weeks after the neurotomy. At this appointment, the patients underwent another electromyogram to determine the presence or absence of denervation potentials. The electromyographer (KP) was blind to the side or levels that had been treated in each patient. The patients repeated the lifting tasks under the direction of the same investigator (BH) and completed the same written outcome assessment tools that were administered before the neurotomy. In addition, they completed the treatment satisfaction scale and the expectations-met scale of the North American Spine Society outcome instrument.⁵ At this follow-up, patients were discouraged from seeking any alternative health care for residual symptoms. Except for the electromyogram and lifting tasks, identical assessments were repeated at 3 months, 6 months, and 12 months.

Median scores and interquartile ranges of all outcome measures were calculated. The Friedman, 2-way analysis of variance was used to determine differences and changes between baseline and the 6-week, 3-month, 6-month, and 12-month outcome data. The Wilcoxon paired test was used to assess any significance of differences between preneurotomy and postneurotomy data from the lifting tasks. Spearman correlation coefficients were used to assess for any correlation between impedance, minimum voltage required to obtain a multifidus twitch at the time of neurotomy, and the presence or absence of multifidus denervation after neurotomy. The proportions of patients obtaining selected grades of pain relief at progressively longer periods of follow-up were calculated.

■ Results

No patient had any complications. All fully completed all follow-up visits. Statistically significant differences

Table 2. Outcome Measures and Scores After Lumbar Radiofrequency Neurotomy in 15 Patients

Outcome Measure	Outcome Score (Median and Range)					P-Value
	Pretreat	6 Weeks	3 Months	6 Months	12 Months	
SF-36						
Physical function	60 [15–95]	95 [25–100]	90 [30–100]	90 [30–100]	90 [40–100]	0.0001
Bodily pain	45 [23–90]	77 [33–90]	80 [55–90]	80 [45–100]	70 [33–100]	0.0015
Roland–Morris	7.0 [2–18]	1.0 [0–9]	1 [0–7]	2 [0–12]	2 [0–13]	0.004
McGill						
Total word count	12 [5–40]	4 [0–21]	3 [0–13]	4 [0–21]	9 [0–21]	0.0013
BDI	6.0 [0–16]	3.0 [0–12]	3.0 [0–12]	3.0 [0–10]	3.0 [0–17]	0.55
VAS (0–10)						
Present pain	4.2 [0.5–7.5]	0.5 [0.0–3.8]	0.2 [0.0–2.1]	1.1 [0.0–7.0]	1.0 [0.0–2.9]	0.001
Weekly average	5.1 [2.0–9.0]	0.7 [0.0–4.0]	0.2 [0.0–2.1]	1.2 [0.0–2.1]	1.0 [0.0–2.6]	<0.0001
Floor to waist lift	58 lbs [24–90]	63 lbs [35–100]	—	—	—	0.091
Above shoulder lift	99 lbs [34–190]	112 lbs [43–169]	—	—	—	0.95
Push	80 lbs [61–123]	89 lbs [54–136]	—	—	—	0.13
Pull	75 lbs [55–102]	74 lbs [38–105]	—	—	—	0.091
Satisfaction (range: 1.2–5.8)	—	4.7 [3.2–5.6]	5.2 [4.4–5.8]	5.0 [3.5–5.8]	5.0 [3.2–5.8]	0.145
Expectations (pretreatment)	4.3 [3.0–5.0]	4.0 [2.6–5.0]	4.2 [2.6–5.0]	3.8 [2.5–5.0]	4.0 [2.3–4.8]	0.12
Expectation met (posttreatment) (Range: 1–5)	—	—	—	—	—	—

BDI = Beck depression inventory; VAS = visual analog scale.

were observed between the pretreatment and posttreatment scores in nearly all outcome measures (Table 2). Although performance in lifting tasks and push–pull tasks improved slightly, the changes were not statistically significant. In every other measure, however, statistically significant, clinical improvement was seen. The improvements in VAS scores were dramatic and profound and correlated with improvements in the MPQ, SF-36, and Roland–Morris scores.

When group scores were compared, improvements were maintained throughout the follow-up period. Scores were not significantly different at 6 weeks, 3 months, 6 months, and 12 months. Patients' satisfaction remained stable throughout the period of follow-up without significant differences, and there was no significant difference between patients' expectation and expectations met at follow-up, including 12 months after neurotomy.

A somewhat different picture emerges, however, when the history of individual patients after neurotomy is considered (Figure 6). At 6 weeks, all but one patient exhibited dramatic reduction in pain. Nine patients rated the pain as 1 or less on the VAS, and a further three rated it as 2 or less. Another patient scored 4 at 6 weeks but continued to improve to a level of nearly 0 by 3 months. The best results were seen at 3 months when all patients had VAS scores of 2.1 or less. Thereafter, nine patients maintained or improved the reduction in pain until the 6- or 12-month follow-up. Between 6 months and 12 months, two patients experienced relapse from levels of 0.0 and 1.1 to levels of 1.1 and 2.5, respectively. Curiously, five patients reported a rebound of pain at 6

months but dramatic restitution of previously good levels of pain relief by 12 months. On inquiry, these rebounds were found to be attributable to concurrent causes of pain unrelated to the previously diagnosed zygapophysial joint pain. One patient had herpes zoster. One had trochanteric bursitis, and another had sacroiliac joint pain, with both conditions responding to diagnostic blocks of the painful structures. These patients were aggressively treated for these conditions. Another patient experienced depression after a life crisis.

Allowing for these episodes of concurrent illness, the individual histories of the patients are consistent with the group median scores. Once established, pain-relief from lumbar medial branch neurotomy remained stable for at least 6 months. The majority of patients remained stable for up to 12 months, but some showed gradual return of pain, consistent with regeneration of the coagulated nerves.

The degree of improvement obtained by all patients is summarized in Table 3. Some 47% of patients obtained an absolute reduction of at least 5 of 10 in the VAS, and 60% obtained a reduction of at least 3. Some 60% of patients obtained a relative reduction of at least 90% in VAS, and 87% obtained a reduction of at least 60%. Two thirds of the patients scored 1.1 or less on the VAS at 12 months, and 6 of 15 scored 0.0 or 0.1.

Fourteen of the patients used no treatment cointerventions during the 1 year of follow-up. One patient had 18 visits to a chiropractor at 10–12 months after neurotomy for residual back pain (rated as 1.8 on the VAS), and this same patient used opioids (30 mg codeine alternat-

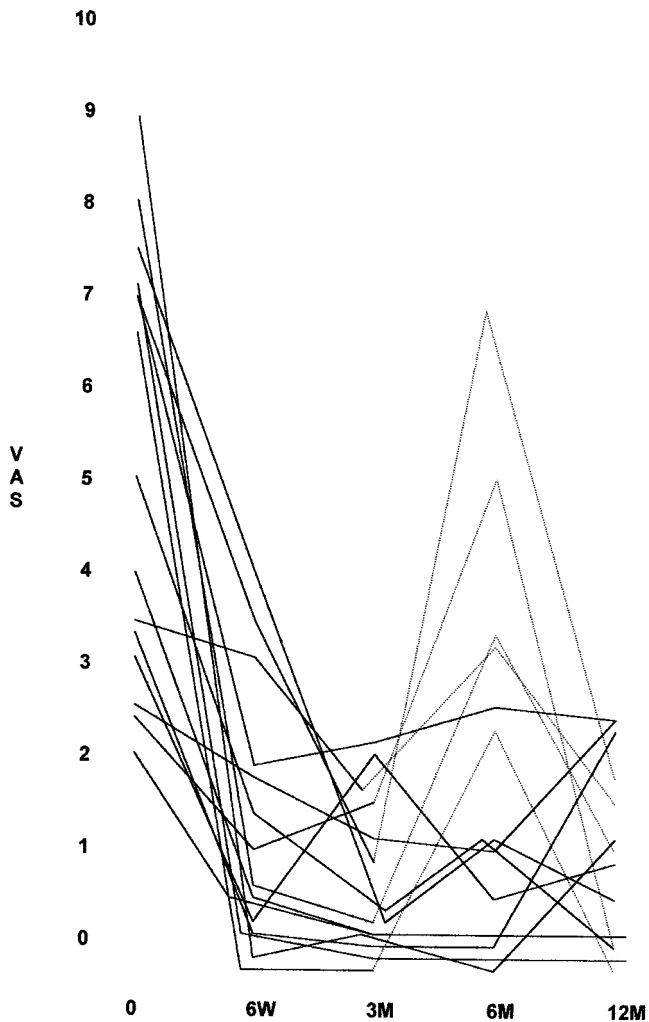


Figure 6. The evolution of the weekly average visual analog scale (VAS) pain scores of 15 patients treated by lumbar medial branch neurotomy: 0, before surgery; 6W, 6 weeks; 3M, 3 months; 6M, 6 months; and 12M, 12 months after surgery. The dotted lines refer to patients who reported temporary pain during follow-up of causes other than zygapophysial joint pain.

ing with 5 mg of hydrocodone, every 8 hours) for residual back pain, but only at the 12 month follow-up visit.

Of the 64 medial branches targeted, 90.5% were assessed by electromyogram to have been coagulated. Of the 15 patients, 11 had a 100% denervation rate, and four had a partial denervation rate, with an average of 65% of targeted nerves having been coagulated. There was no correlation between impedance values just before neurotomy and the presence or absence of denervation after neurotomy ($r = 0.10$; $P = 0.725$). There was no correlation between the minimal voltage required to elicit a multifidus twitch and the presence or absence of denervation ($r = 0.61$; $P = 0.83$). Nor was there any correlation between the rate of successful denervation and the proportion of patients achieving any selected degree of pain relief. Noncorrelation was due to the high rate of successful denervation. As assessed by electromyogram, denervation was achieved in virtually all pa-

Table 3. Numbers of Patients and Cumulative Numbers (ΣN) Obtaining Specified Changes in Visual Analog Scores (Δ VAS) and Percentage Improvements in Visual Analog Scores (Weekly Pain Ratings) at 12 Months After Lumbar Medial Branch Neurotomy

Δ VAS	N	ΣN	% Improvement	N	ΣN
10	0	0	100	5	5
>9	0	0	90–100	2	7
>8	0	0	80–90	2	9
>7	4	4	70–80	2	11
>6	1	5	60–70	1	12
>5	2	7	50–60	1	13
>4	1	8	40–50	0	13
>3	1	9	30–40	0	13
>2	3	12	20–30	1	14
>1	1	13	10–20	0	15
>0	2	15	0–10	1	15
0	0	15	0	0	15

tients, all of whom obtained some degree of relief. In 11 of 15 subjects, there was denervation seen in every segmental multifidus muscle (100%) that pertained to the targeted nerves. In the remaining 4 subjects, there was denervation in 83%, 83%, 75%, and 17% of the segmental multifidus muscles that pertained to the targeted nerves. The one patient in whom relief was the poorest was the patient with the lowest (17%) denervation rate on post- versus preradiofrequency neurotomy segmental multifidus electromyogram.

Discussion

The current study differs in several respects from all previous studies of lumbar medial branch neurotomy. Foremost, it is the first prospective study to have treated only patients with zygapophysial joint pain verified with controlled diagnostic blocks. Next, it is only the second study in which an operative technique was used that is anatomically and technically accurate. Third, it is the only study to have shown accurate and adequate coagulation of the target nerve by objective means. Fourth, it is the only study in which multiple, subjective, and objective outcome measures were recorded during a prolonged follow-up period.

Under these conditions, lumbar medial branch neurotomy offered profound and lasting relief of back pain. In this regard, the results of the current study complement and extend those obtained by Van Kleef et al¹⁹ in their controlled trial. If patients are rigorously selected, and if accurate surgical techniques are used, some 60% of patients can expect at least a 90% reduction in pain, and 87% can expect at least a 60% reduction, lasting 12 months. The results of the current study do not validate the efficacy of medial branch neurotomy performed in any way other than as described herein.

The electromyogram data from the current study indicate that the operative technique used was effective in

coagulating the target nerves. The relief of pain obtained by the patients is concordant with the demonstration of postoperative denervation in the respective bands of multifidus and is fully consistent with the rationale for medial branch neurotomy. However, the results of the current study dispel some of the myths and conventions concerning the performance of medial branch neurotomy. The use of preliminary electrical stimulation of the medial branch nerve to verify electrode placement appears to be superfluous and an unnecessary consumption of operative time. Adjusting the electrode position to minimize the threshold for evoked activity in the multifidus does not improve outcome. The essential requirement is that the electrode be placed in an anatomically sensible and accurate position, which can be judged radiologically and by the operator's sense of the needle in the target osseous groove.

A modified comparative block protocol was used to identify symptomatic zygapophysial joints. Comparative blocks involve anesthetizing the target joint on two separate occasions using different local anesthetic agents. When tested against placebo blocks, comparative blocks yield valid responses.¹⁰ They are highly specific (*i.e.*, have few false-positive responses) when optimum criteria are applied, which are that the patient obtains long-lasting relief when the longer acting agent is used but shorter lasting relief when the shorter acting agent is used.¹⁰ These criteria, however, reduce the sensitivity of the test (*i.e.*, not all patients with zygapophysial joint pain are detected). If the criteria are relaxed so that the patient obtains complete relief of pain on each occasion when the joint is blocked, but regardless of the relative durations of effect, the sensitivity increases with some loss of specificity, but sufficient specificity remains for practical purposes.¹⁰

For the current study, specificity was sacrificed in the interest of sensitivity. The objective was to maximize the yield of eligible patients. Accordingly, the criteria for a positive response using this modified comparative block protocol was that the patient obtained 80% or more relief of pain on the occasion of each block, and provided that they obtained more than 1 hour of relief after lidocaine and more than 2 hours of relief after bupivacaine. Moreover, patients were monitored until relief ceased or for 6 hours, whichever was the lesser.

Although use of sensitive but less than optimally specific criteria theoretically threatens the validity of the inclusion criteria, this risk was taken premeditatedly in the interest of securing putatively positive patients expeditiously. The risk was that if patients returned false-positive results, they would not respond to treatment. The results show that this was not the case.

The results of the current study, however, sound a warning against the wholesale implementation of lumbar medial branch neurotomy. The 15 patients described were selected from an initial population of 460. The pro-

cedure, therefore, may be applicable only in a minority of patients with back pain. Substantial exclusion criteria were applied to select patients with pure zygapophysial joint pain, to maximize the possibility of success. Whether the procedure may work in patients with other types of pain remains to be demonstrated. Coupling the results of the current study with those of Van Kleef et al¹⁹ indicates that in carefully selected patients with back pain uncomplicated by comorbidity and psychosocial factors and with the use of meticulous surgical technique, lumbar medial branch neurotomy can provide marked relief to patients with verified zygapophysial joint pain.

■ Key Points

- Lumbar radiofrequency neurotomy for chronic zygapophysial joint pain is an effective treatment.
- Adequate coagulation of the target nerves is technically feasible.
- Electrical stimulation before lesioning is superfluous in assuring correct needle electrode placement.

References

1. Beck AT, Beck RW. Screening depressed patients in family practice: A rapid technic. *Postgrad Med* 1972;52:81-5.
2. Blankenship K. The Blankenship System. Functional Capacity Evaluation. The Procedure Manual. 2nd ed. Macon, GA, The Blankenship Corporation, 1994;9:01-10,47.
3. Bogduk N, Macintosh J, Marsland A. Technical limitations to the efficacy of radiofrequency neurotomy for spinal pain. *Neurosurgery* 1987;20:529-35.
4. Bogduk N, Wilson AS, Tynan W. The human lumbar dorsal rami. *J Anat* 1982;134:383-97.
5. Daltroy LH, Cats-Beril WL, Katz JN, Fossel AH, Liang MH. The North American Spine Society lumbar spine outcome assessment instrument: reliability and validity tests. *Spine* 1996;21:741-9.
6. Dreyfuss P, Schwarzer AC, Lau P, Bogduk N. Specificity of lumbar medial branch and L5 dorsal ramus blocks: A computed tomographic study. *Spine* 1997;22:895-902.
7. Haig AJ. Clinical experience with paraspinal mapping II: A simplified technique that eliminates three-fourths of needle insertions. *Arch Phys Med Rehabil* 1997;78:1185-90.
8. Huskisson EC. Visual analogue scales. In: Melzack R, ed. *Pain Measurement and Assessment*. New York: Raven Press, 1983:33-7.
9. Kaplan M, Dreyfuss P, Halbrook B, Bogduk N. The ability of lumbar medial branch blocks to anesthetize the zygapophysial joint. *Spine* 1998;23:1847-52.
10. Lord SM, Barnsley L, Bogduk N. The utility of comparative local anaesthetic blocks versus placebo-controlled blocks for the diagnosis of cervical zygapophysial joint pain. *Clin J Pain* 1995;11:208-13.
11. Macintosh JE, Valencia F, Bogduk N, Munro RR. The morphology of the lumbar multifidus muscles. *Clin Biomech* 1986;1:196-204.
12. McHorney CA, Ware JE, Raczek AE. The MOS 36-item short-form health survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care* 1993;31:247-63.
13. Melzack R. The McGill pain questionnaire: Major properties and scoring methods. *Pain* 1975;1:277-99.
14. Roland M, Morris R. A study of the natural history of back pain. Part I: Development of a reliable and sensitive measure of disability in low-back pain. *Spine* 1983;8:141-4.
15. Schwarzer AC, Aprill CN, Derby R, Fortin J, Kine G, Bogduk N. Clinical features of patients with pain stemming from the lumbar zygapophysial joints: Is the lumbar facet syndrome a clinical entity? *Spine* 1994;19:1132-7.
16. Schwarzer AC, Aprill CN, Derby R, Fortin J, Kine G, Bogduk N. The false-

positive rate of uncontrolled diagnostic blocks of the lumbar zygapophysial joints. *Pain* 1994;58:195–200.

17. Schwarzer AC, Wang S, Bogduk N, McNaught PJ, Laurent R. Prevalence and clinical features of lumbar zygapophysial joint pain: A study in an Australian population with chronic low back pain. *Ann Rheum Dis* 1995;54:100–6.

18. Valencia FP, Munro RR. An electromyographic study of the lumbar multifidus in man. *Electromyogr Clin Neurophysiol* 1985;25:205–21.

19. Van Kleef M, Barendse G, Kessels A, Voets HM, Weber WEJ, de Lange S. Randomized trial of radiofrequency lumbar facet denervation for chronic low back pain. *Spine* 1999;24:1937–42.

20. Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. *Med Care* 1992;30:473–83.

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