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Facet Denervation in the Management of Back and Sciatic Pain

C. NORMAN SHEALY, M.D.*

In 1971 W. S. Rees reported having performed 2,000 operations using a closed surgical technique in which a long scalpel blade penetrated to the intertransverse ligament with the purpose of severing the posterior rami supply facet articular capsule.⁸ In February, 1972, Dr. Rees further described his procedure at the Pan-Pacific Congress of Surgery in Hawaii. Despite the difficulty in accepting his 99.8 per cent "success," the rationale behind his approach was enough to encourage us to undertake his procedure. Between May and June, 1972, the Rees technique was used in 29 patients at The Pain Rehabilitation Center, S. C., La Crosse, Wisconsin. The very striking relief of pain in over half of these patients, many of whom had been invalids for a number of years, made the procedure seem worthy of further scientific development. Huge hematomata produced in 6 patients, however, forced the evolution of a much less traumatic radiofrequency technique for denervating the spinal facet joints.

Over 200 American surgeons have done the procedure since that time. As so often happens with new and developing techniques, there has been a wide variety of experimentation and the results, therefore, have not been uniformly satisfactory. This

had led to "the old business of professional sour grapes, inept technicians, and improper selection methods."⁷ The significant enthusiasm of a number of very excellent and academically oriented surgeons suggests, on the other hand, that proper selection of patients for the procedure will lead to very gratifying success.

ANATOMICAL AND PHYSIOLOGICAL RATIONALE FOR FACET DENERVATION

At least as early as 1900 it had been reported that sciatica resulted from abnormalities of the lumbosacral articulations.³ In 1927 it was further argued that "sciatica is a neuralgia caused by pathological conditions of the intervertebral foramina and especially of the intervertebral articulations."⁶ In 1934 rupture of the intervertebral disk was first recognized and reported by Mixter and Barr.⁵ Since that time it has been well recognized that disk herniation with back and usually sciatic pain, with decreased lumbar lordosis, with marked paravertebral muscle spasm, with limitation of flexion of the back, with decreased straight leg raising especially with crossed pain, with motor weakness, especially in dorsiflexion of the foot or the large toe, with decrease of the ankle jerk, and with sensory loss in the L5 or S1 dermatome is likely to be adequately relieved by laminectomy.

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* The Pain Rehabilitation Center, S.C., 615 South Tenth Street, La Crosse, Wisconsin 54601.

tomy with removal of the ruptured fragment. For reasons that are not easy to understand, however, surgery for disk herniation which was unknown prior to 1934, has become one of the leading operative procedures in the United States today. The true success rate of such surgery is essentially unknown. Some surgeons have reported good or excellent results in 92 per cent of their patients and that 71 per cent "had been able to continue their former activities or return to their former jobs." These same authors from the hospital that originated the procedure of lumbar laminectomy, reported that there was no difference between simple excision of the ruptured disk and fusion,¹ but fusions continue to be done! Much more extensive series of surgical procedures, however, have revealed that only 30 per cent of patients went back to work within two years.²

A personal review of original operative notes in 250 patients previously operated elsewhere has led to a finding of disk herniation in only 6 of those patients. In 20 other patients the operative notes and history of the patient were insufficient to allow a proper diagnosis in retrospect and in 224 patients the operative notes clearly indicate that the surgery was done only for mildly bulging degenerated disk without true herniation.

Such cases have led us to believe that pain in the back, with or without sciatic radiation, may stem from periosteum, ligaments, muscles, joints, nerve roots, or branches of the nerve roots to periosteum, ligaments, muscles or joints. The pain may be radicular or focal with findings of paravertebral muscle spasms, tenderness, limitation of flexion of the back as well as limited straight leg raising; sensory subjective evidence of numbness is very common, usually with relatively minor sensory loss on pinprick and touch testing. Subjective weakness is a very common response to pain and muscle "holding" because of pain often leads to

apparent weakness and even to apparent reflex changes. The same clinical picture can be found with a variety of physical causes, ranging from tumor, to infectious processes, to various relatively minor degenerative and traumatic abnormalities. Results of selective nerve blocks of various parts of the back from the facet joints to the roots themselves reveal that pain and sciatica with the associated phenomena of muscle spasm, limitation of motion, and reflex and sensory subjective changes may occur from disturbances as high as L1 and on some occasions occur from facet disturbances on the opposite side of the body. In previously unoperated patients with chronic pain, 79 per cent of the time such pain has been found to come from one or more disturbed facet joints, 20 per cent of the time it comes reflexly from a disturbance of the sacro-iliac joint and only 1 per cent of the time has it been found to be due to a ruptured disk.

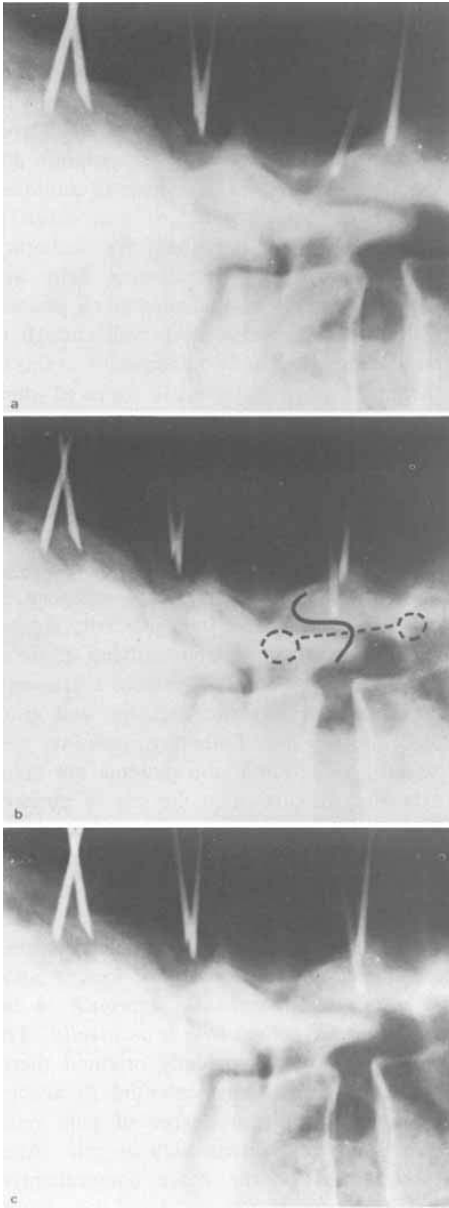
The latter being true, it seems inappropriate to subject all of the patients with such symptoms to contrast diagnostic procedures since myelography may carry a risk of 4 or 5 per cent late arachnoiditis and at least 30 per cent have false positive abnormalities.⁴ This has led to the development of an aggressive conservative approach to back pain either acute or chronic. Since this program seems essential for maximum success with facet denervation, we outline it here.

Management of back and sciatic pain problems when there is no significant nerve deficit: Patients who are significantly suffering with muscle spasm, limitations of motion and pain, either in the back or with sciatic component, are obviously first evaluated physically and neurologically, and screening tests of CBC, sedimentation rate, and SMA-12 are done. A 2-hour postprandial blood sugar or glucose tolerance test is also obtained. Patients are usually placed in bed for one night, during which time external electrical stimulation is applied to the back

with electrodes placed on either side of the pain, but not directly over the most tender spot.^{9, 10} Ice applications in the form of THERAPAC®, a solid frozen plastic pack which dispenses its cold and melts within 20 minutes, are applied to the area of pain four times a day. Patients, if they are in extreme agony, are given Demerol or Codeine on a q 4 h basis, never prn. The following morning, if the patient is not beginning to show significant improvement, acupuncture is done. This consists of needling with twisting of the needle in the traditional Chinese fashion along the area called the bladder meridian in the lumbar spine; this actually overlies the facet joints. The needles are inserted approximately 1½ inches in depth, twisted several times about 180° in either direction and withdrawn. The lowest point, called Bladder 26, overlies the sacro-iliac joint. This area is often needled very vigorously with a regular #19 gauge needle which is pounded into the periosteum half a dozen times; and although the treatment itself is usually exquisitely painful, it has been extremely useful in many patients who have acute and chronic pain. The external electrical stimulation and ice are continued and the patient is then advised to walk as much as possible but not to do any other bending exercises. The majority of patients are markedly improved by the following day. If they are not significantly improved by that time, patients are taken down to the X-ray department where, under image intensification, the facet joints are blocked with 1½ cc 0.25 per cent Marcaine® on top of any tender facet joint. If that does not relieve the patient's pain, then a #19 gauge lumbar puncture needle is inserted under fluoroscopic guidance into the sacro-iliac joint either unilaterally or bilaterally depending upon the patient's pain and 6–10 cc of 0.25 per cent Marcaine is injected into the sacro-iliac joint. The vast majority of patients have responded to this approach and in a few

of them where the pain has returned when the block wears off we have repeated the Marcaine block at the joint which seemed to be responsible for the patient's pain, with the addition of a total of 80 mg of Depo-Medrol. External electrical stimulation and ice are continued. The patient is continued on the walking program, is sent down to physiotherapy for deep heat via diathermy, plus Hubbard tank treatments daily and within 4–5 days of that almost all patients with acute pain have been well enough to be discharged. The two exceptions to this in the past four years have had ruptured intervertebral disks, which were subsequently diagnosed by discography and removed at surgery.

Management of chronic back and/or sciatic pain when the patient has become an invalid (usually with multiple previous surgical procedures): In this category of patients where almost total inactivity is present, the simple approach outlined above is inadequate. A more aggressive therapeutic program with vigorous massage and gradually progressive limbering exercises are added. In addition, the patients are given extensive instruction in the use of biofeedback and autogenic training techniques¹¹ for control of their physiology and consideration of facet nerve blocks and possibly denervation is delayed until a week or ten days after beginning such a program. Even then *facet denervation is not looked upon as a primary therapeutic approach in the chronic back patient who is an invalid.* The more psychophysiologically oriented therapeutic program seems essential to accomplish any significant degree of pain relief in a group of patients such as this. After careful trial of the more comprehensive approach, if pain persists, facet denervation is considered. Initially, using fluoroscopic assistance, #19 gauge spinal needles are inserted to touch the top and center of all tender facets. One and a half cc of 0.25 per cent Marcaine are injected directly on top



FIGS. 1A to C. Lateral X-rays showing the same three electrode positions; indicates the location of the transverse processes and the intertransverse ligament.

of facet joints. If total or near total pain relief is accomplished for 2 to 8 hours, then facet denervation is indicated.

The technique for radiofrequency facet denervation: Prior to the procedure lateral and AP roentgenograms of the lumbar spine are taken to locate the facets. Obliques are also helpful in demonstrating the degree of osteoarthritic change. The patient is placed prone on a fluoroscopy table, the back is prepared and draped as for a myelogram. The patient is alert and should be able to discuss with the surgeon sensations during the procedure and thus is given only mild pre-operative sedation. The patient's legs are usually wrapped with elastic bandages to prevent vasovagal hypotension during the procedure. The facets that are to be tested for possible denervation are located under X-ray guidance and 1 per cent lidocaine is placed intradermally in the site above each facet in question. A #12 gauge special thin-walled needle with a solid stylet is introduced directly through the skin and muscle to touch the facet. In most patients this would be carried out at L3-4, L4-5, and L5-S1 bilaterally. The radiofrequency probe is then advanced through the needle, the needle is drawn back up the shaft of the electrode and out of the skin. The radiofrequency electrode is electrically insulated along its shaft except for a 7 mm exposed tip (Fig. 1). The RF electrode is now manipulated over the edge of the facet, down to the depth of the intertransverse ligament and approximately lateral to the center of the facet (Fig. 2). The elastic resilience of the intertransverse ligament is very distinctly felt, but a lateral roentgenogram or a C-arm fluoroscope will confirm the depth of the electrode.

Electrical stimulation through the electrode is used to determine whether the electrode tip is located properly and if so whether the nerve should be coagulated. It

obviously also will determine if the electrode tip is too close to the primary spinal nerve root. Using a pulse duration of 1 millisecond, electrical stimulation is carried out at 25 pulses per second with the voltage raised slowly up to between 2 and 3 volts. The patient is then asked whether the pain evoked reproduces pain in the area of the patient's clinical pain syndrome. On those occasions when the electrode tip is too close to the primary spinal root, severe radicular pain in a characteristic dermatome distribution occurs, usually with less than 1 volt; and muscle contractions occur between 1 and 2 volts. Under those conditions the electrode is too deep and must be withdrawn and re-positioned. Patients must be distinctly questioned to be positive no muscle contraction is elicited in the leg; paraspinal muscle contraction is seen routinely. The pain experienced by the patient during electrical stimulation is usually interpreted as being very similar to the original pain but the most important aspect is whether it is in the right distribution. Often pain radiates into the buttock and along the sciatic distribution but rarely distal to the knee. Diffuse radiation into the foot is rather uncommon and only extremely rarely is there pain into the foot or toes along the dermatomal pathway. In that case, a lateral roentgenogram must always be taken to be certain that the electrode tip is not too close to the nerve root. Occasionally, there are referral components of the pain to the contralateral area of back and buttock and this is more common in patients with previous fusions. Both anterior thigh pain and sciatic pain may be evoked by stimulation of any lumbar facet from L1 down to L5-S1. If pain in the proper distribution is not elicited on electrical stimulation, no lesion is made. When pain in the proper distribution is evoked the RF generator is activated with the temperature of the ther-

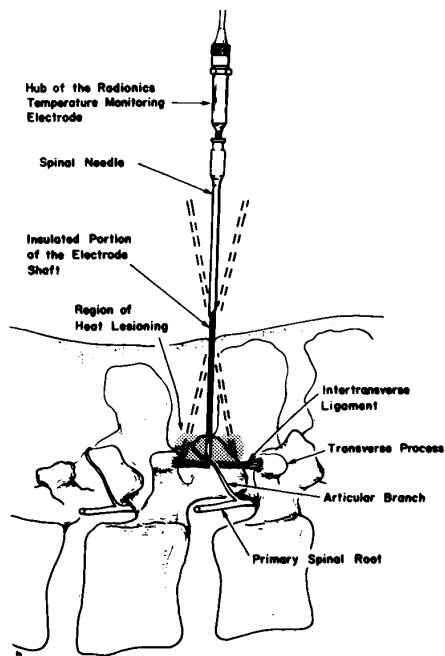


FIG. 2. The three electrode positions during lesioning and the region of electrocoagulation.

mister raised to 80–82 degrees with a 50-second lesion in the lateral central position (Fig. 3). The electrode hub is then deviated superiorly for 50 seconds and caudally for 50 seconds for a total heating time of 150 seconds. The stimulation, and when indicated coagulation, is carried out at each appropriate facet joint. All the needles and the electrode are then withdrawn and a small sterile dressing is applied. The patient is immediately ambulated and begun on a series of limbering exercises.

COMPLICATIONS

In 380 patients treated at The Pain Rehabilitation Center, La Crosse, there have been no neurologic deficits of any sort in

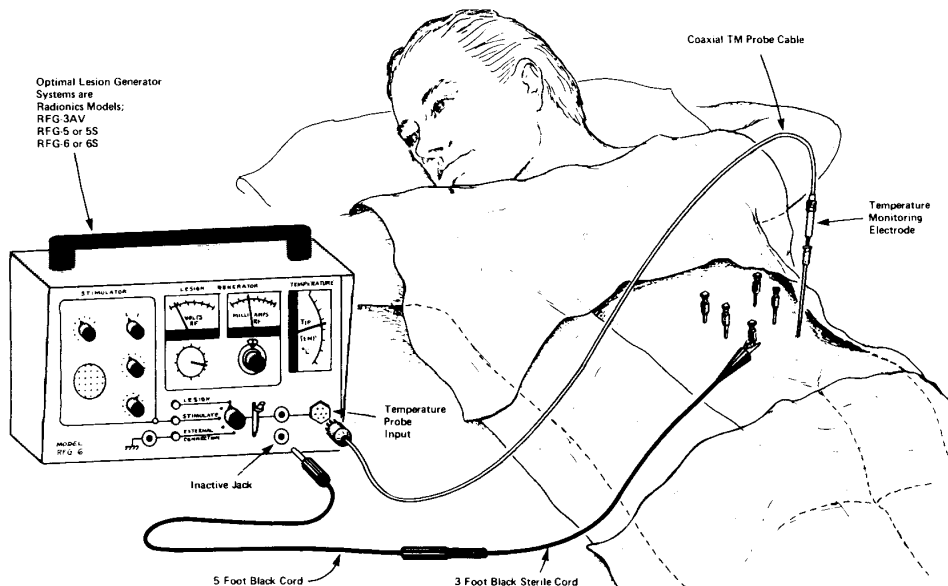


FIG. 3. Necessary cable connections for stimulating and lesioning.

the lumbar series of patients. Four patients received small superficial burns from leakage in the insulation on the electrode. In the cervical patients there were two who had a small patch of numbness in the C2 distribution when lesions were made at C2-3. There was one patient with a small patch of midline numbness in the area between the base of the neck and the scapula from lesions in the lower cervical area. None of these have been troublesome and probably these come from the proximity of the branches of the rootlets going to those areas rather than from destruction of the roots themselves. There have been no such problems in the lumbar spine. There are no known problems with trophic joint changes, although only a few patients have been X-rayed two years or more after the procedure.

Eighty-two per cent of primary low back pain patients have benefited significantly. Only 40 per cent of those with earlier sur-

gery and 29 per cent of those with previous fusion have been helped. Criteria for pain improvement are based on the pain profile.¹² All these 235 patients have been followed a minimum of 6 months; the longest case has now been followed 37 months (mean is 27 months now).

Results of the Facet Denervation by Other Surgeons. Dr. Charles Burton at Sister Kenny Institute of Minneapolis has performed approximately 120 procedures over a 3-year period. He believes "the procedure to be the treatment of choice in patients with pure mechanical syndromes who have never been operated upon and who fulfill the following criteria: (1) back and/or leg pain may not radiate below the knee; (2) pain is present only with activity and is completely relieved by bedrest; (3) neurologic examination is not remarkable (sensory examination must also be normal); (4) predisposing factors to articular disease such as: asymmetry of the facets, shallow

TABLE 1. Results (LaCrosse)

	<i>Failed</i>	<i>Good</i>	<i>Excellent</i>
Group I—Patients with no previous spinal surgeries ("virgin" backs)			
Lumbar	9	10	32
Thoracic	1	1	2
Cervical	4	0	4
Group II—Patients with previous spinal surgeries but without fusion			
Lumbar	35	8	15
Thoracic	3	1	1
Cervical	3	0	0
Group III—Patients with spinal fusion			
Lumbar	69	14	14
Thoracic	0	0	1
Cervical	4	2	2
Total = 235 patients			

lumbosacral angle, inequality of leg length, pelvic tilt, and scoliosis are present.

The long-term beneficial results appear to be approximately 30–40 per cent at this time and this is a quite reasonable return."

Dr. William Finney of Baltimore reports that he has treated approximately 170 patients and his associate, Dr. D. Graham Slaughter, has treated 100. "We find the procedure extremely helpful in those patients with virgin backs whose pain is relatively local or radiating to the buttock and is worse on hyperextension. Our results have been approximately 80 per cent in the excellent and good group and in this group we have had no repeat rhizotomies. This group has numbered approximately 110 in all. Our next favorable group has been those who have had previous disk surgery but without fusion. Our good and excellent results in this group, again with a minimum of sciatic component, have been 60 per cent and in this group we have redone 17. Our next group is that of patients who have been fused and either have a pseud-

arthrosis or continuance of their pain; approximately 50 per cent of that group of patients has been helped."

Discussions with several other neurosurgeons with similar series have yielded comparable statistics. However, we frequently learn that surgeons are trying wide variations of the technique, sometimes using cordotomy electrodes, making their lesions directly on the facets rather than lateral to the facets where the nerve actually is traveling and not selecting patients according to the criteria which were outlined earlier. Results from surgeons who are following less vigorous criteria than those that have been outlined are not nearly so encouraging. Furthermore, when the patient is indeed an invalid, the facet denervation procedure alone is quite inadequate to get most patients rehabilitated and a more aggressive approach of physical exercise and psychophysiological rehabilitation is necessary. Overall, facet denervation is infinitely safer than chemonucleolysis; it is more physiologically rational and results are superior.

A few surgeons have used both hypertonic saline and 4 per cent phenol in glycerine for making lesions. We have not used this in the lumbar area, but in the cervical and thoracic area, in a half dozen patients, the 4 per cent phenol in glycerine $\frac{1}{2}$ cc injected directly over the center of the facet joint has been satisfactory and it seems more esthetic than the radiofrequency procedures in these more difficult areas. Precautions must be taken under X-ray control to be certain that the phenol is properly positioned. Although facet denervation is not necessarily more successful than the best surgical series reported, its safety and simplicity make it worth serious consideration before a more aggressive surgical approach. Furthermore, it is far safer than chemonucleolysis.

SUMMARY

Back pain, with or without sciatic radiation, may come from a number of anatomical sites. Radiofrequency facet denervation suggests that a majority of patients seem to have pain referred from distress of the facet joints or the sacro-iliac joints. In those patients who are properly selected and have not had previous surgical treatment, radiofrequency denervation of the appropriate facet joints yields partial to total relief of pain in 82 per cent of cases. The technique for doing this procedure and for selection of patients must be followed very closely but in over 800 patients surveyed for this report no neurologic complications have been reported. Facet denervation, when indicated, is proposed as a safe alternative to either chemonucleolysis or surgery.

ACKNOWLEDGMENT

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