Electromyographic Analysis of the Lumbar Musculature in Patients Operated on for Lumbar Rhizopathy

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IMPAIRED mobility, fatigue, or back pain are reported by a good many patients operated on for herniated disc or other complaints in the lumbar region. In electromyographic studies of a number of such cases several years after surgery for herniated disc, we have found signs of denervation in the spinal muscles. Postoperative denervation of this sort has previously been reported by Weddell, et al., in 1944, Mack in 1951, and Aguilar in 1963, 9, 6, 1

The denervation cannot be attributed automatically to the operation, since the underlying disease may also be responsible. Nor is the denervation necessarily connected with the patient's subjective discomfort; consequently, patients without this discomfort should also be investigated. This gave rise to the present study, in which an unselected series of patients was examined electromyographically and clinically before the operation as well as at various intervals up to 12 months postoperatively.

Materials and Methods

The patients were 51 consecutive cases with clinical signs of lumbar root involvement, admitted to and operated on in the orthopedic department of a university clinic. Of these patients, 25 were women and 26 men; 21 were 40 to 40 years old, and 30 were 40 to 60 years old. It was the first operation for 49 of them, the other two having been operated upon previously for lumbar discs, one on the ipsilateral side, the other on the contralateral side in relation to the present operation.

Surgical Method. The operation is performed under intubation anesthesia, with the patient lying prone and the lumbar spine in maximal kyphosis. The operation field is infiltrated with a saline-adrenalinone solution. The skin is incised lateral to the spinous process, and the spinal musculature is freed at the periosium from the lateral surface of the spinous process and from the dorsal surface of the vertebral arc towards the intervertebral joint. The lumbo-sacral space is exposed. If necessary, the next space above is also exposed; in general, however, the field exposed is kept as small as possible. The nerve root is exposed after due resection of the vertebral arc or sometimes via the transligamentary route. Electrocoagulation is never used ventral to the muscles.

Findings at Operation. The operation was performed unilaterally in 49 patients, of whom 29 had prolapse and 16 protrusion of the disc; 3 of the cases were found to have fibrous tissue around the nerve root, while in one case no pathological signs could be detected. The remaining 2 cases in the series required laminectomy with bilateral dissection of the musculature; one of these cases had a large medial prolapse of the disc, the other a cavernous angiomata.

Spinal fusion was not performed in any of the cases. The operations were done by six different surgeons; however, two of them were responsible for 80% of the series.

Electromyographic Technique. Concentric needle electrodes (Disa type 13K06) were used. Lower extremity and spinal muscles were examined in each case but only the latter muscles will be considered in this report. Electromyography of the spinal muscles was done 2 to 3 cm lateral to the spinous process. At the preoperative examination, insertions were made from the level of the spinous process of L-3 to that of S-2 or S-3. For each insertion point, recordings were generally made from four to five different depths. The patient lay prone; activation of the muscles was achieved by having the patient press his abdomen against the examination table and at the same time raise his shoulders and legs.

The same procedure was used for the post-
operative examination, except that the number of insertions was usually greater because the full length of the surgical scar was examined and this generally extended higher than L-3 or L-4. Control insertions were regularly made on the unoperated side.

The result for each insertion point was classified under one of four headings, ranging from "normal findings" to "total denervation," the extent of denervation being recorded objectively on an oscilloscope and also from film. Spontaneous fibrillations and positive sharp waves were taken to represent denervation activity. No heed was paid to occasional fibrillations or "injury activity" (Kugelberg, 1952). The classified results were entered on a chart together with the the location of the surgical scar, indicated as exactly as possible. The interchrisia line was used for the location of the spinous process of L-4.

Results

An electromyographic examination and a clinical assessment of the patients were made preoperatively and 6 to 8 weeks, 5 to 7 months, and in some cases, about 12 months after the operation.

Preoperative Examination. All 51 patients were operated upon with root involvement as the indication; this was assessed from an evaluation of subjective discomfort, clinical findings, lumbar myelography with positive contrast medium (H₂O-soluble contrast U) and, in 41 cases, electromyography. There were various reasons why electromyography was not undertaken in the other 10 cases. In some, the subjective pain precluded such an examination; in others, the patient’s discomfort had lasted only a few days prior to admission, suggesting that no signs of denervation would be found. Since, however, the indications for surgery and choice of operation did not differ from the rest of the material, these patients were included in the follow-up.

Of the 41 patients examined, signs of denervation in the spinal musculature were present in 17 and absent in 24. The 17 denervated cases included the two previously operated on. The signs of denervation in the other 15 were moderate, that is, spontaneous fibrillations or positive sharp waves were found at several levels but not as a rule for all the insertions. In these patients, greater weight was attached to the presence of denervation activity as a sign of root involvement than to a reduction in the number of potentials recruited during maximal voluntary contraction. The reason of course was that the pain not infrequently prevented the patients from fully activating the musculature.

It should be noted that among the 15 previously unoperated patients there were three who had signs of denervation in the spinal musculature but not in the leg muscles, which were examined at the same time. This is interesting in that it focuses attention on the root region as the origin of the symptoms in these cases. Two of these patients had a herniated disc but the third had a root embedded in fibrous tissue.

On the basis of the location and extent of the denervation in the spinal muscles, an attempt was made to determine which root was affected. A comparison with the findings at operation showed that results from electromyography gave a correct indication of the level in 10 of the 15 previously unoperated cases.

Of the 24 cases in which denervation activity was not observed, 7 were examined less than 3 weeks after the onset of symptoms. Since denervation activity does not as a rule appear sooner than this after injury to a nerve, the negative finding is of little consequence in this context. These patients might well have shown denervation activity if they had been examined at a later date. Of the remaining 17 patients, 9 were denervated in the leg, suggesting that in root involvement by a herniated disc the nerve fibers to the leg muscles are affected somewhat more frequently than those to the segmental spinal muscles. One of the reasons for this may be differences in the location of the fibers in the root or a greater vulnerability of the long fibers (Kugelberg and Petersén, 1950).

At operation, 4 patients had doubtful or negative findings; no clearly herniated disc was discovered. No sign of denervation had been detected at electromyography in 3 of these patients, while the fourth had a root embedded in fibrous tissue.

The patients’ clinical findings are summarized in Table 1 and the results of a typical electromyogram are reproduced in Fig. 1.

First Postoperative Examination (after 5 to 7 weeks). All 50 patients examined had signs of denervation in the spinal musculature.