

## SENSORY CHANGES WITH HERNIATED NUCLEUS PULPOSUS

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**I**N RECENT years it has become common to perform surgery for herniations of the nucleus pulposus without myelographic verification, and many<sup>1,2,4-10</sup> believe that an accurate diagnosis can be made on clinical findings alone. In fact, Keegan<sup>4-9</sup> has devised a new dermatome chart based almost entirely on sensory changes in patients with herniated nucleus pulposus. In doing this he must assume that the majority of herniations involve only one nerve and are complete lesions, although he does note that in some instances there may be a lesser degree of compression, in which case, the

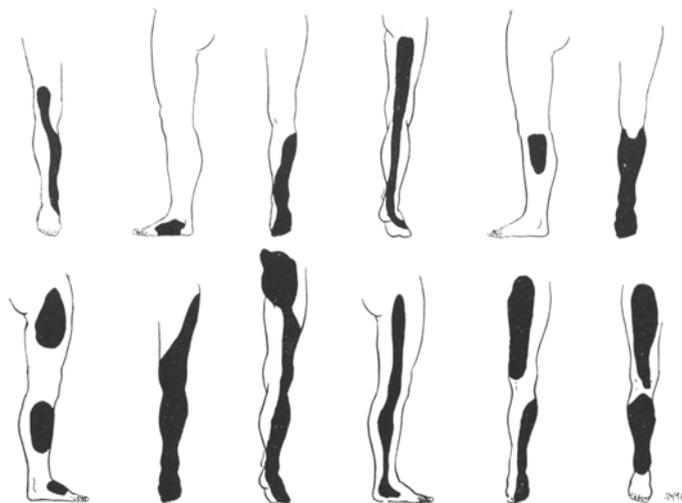


FIG. 1. Some of the variety of sensory patterns accompanying herniations of the nucleus pulposus at the L4-5 interspace.

localization may be misjudged. He states also that more than one nerve may be involved in a single herniation and that a more lateral, or more medial herniation than usual may be misleading.

On the basis of light pin scratch sensibility, Keegan has outlined dermatome areas for each of the posterior spinal nerve roots and states that the outlining of this so-called dermatome hypalgesia is diagnostic of single nerve involvement. Spurling and Grantham,<sup>10</sup> on the other hand, state that touch and temperature tests reveal sensory changes better than pin prick. They

also believe that myelography is not necessary in the majority of cases and that the level of the herniation can be diagnosed by sensory changes, but their sensory charts are different from those of Keegan. Falconer, Glasgow and Cole<sup>3</sup> describe sensory changes extending up the leg into the buttock, similar to, but not exactly like, Keegan's findings. However, they state that when the pain is severe, sensory impairment may become more extensive than can be explained on a segmental basis alone. They found extensive

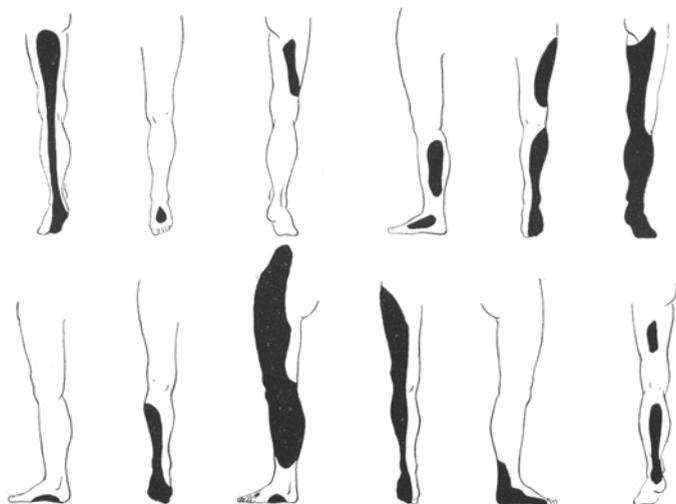


FIG. 2. Some of the variety of sensory patterns accompanying herniations of the nucleus pulposus at the L5-S1 interspace.

overlap, which Keegan did not find, and in several cases found a sensory loss confined to the foot and leg alone.

We have made a study of the sensory changes in 500 consecutive patients with surgically verified herniated nucleus pulposus. In all but 38, myelography was performed and the lesion verified. Eighteen of the herniations were in the cervical region, 201 at the L4-5 interspace, 234 at the L5-S1 interspace, and the remainder scattered at various levels throughout the spinal column or in multiple locations. Of the 500 patients, 327 had demonstrable sensory changes, which were extremely variable. Herniations at the L4-5 interspace alone produced 38 different patterns of sensory involvement varying from a small area of diminished sensation on the lateral aspect of the calf to hypalgesia of the entire thigh, leg, and foot (Fig. 1). Herniations at the L5-S1 interspace produced 29 different sensory patterns (Fig. 2).

It was interesting and significant to note the variability of the sensory findings with each particular examiner. These examinations were done by the authors and 6 other neurosurgical fellows and comparisons made. Pin prick and light pin scratch stimuli were used. The results also depend to some extent upon the patient's intelligence, suggestibility and psychic makeup.

These variable factors mitigate greatly against accurate localization of the level of the lesion by sensory loss alone.

Of the 201 patients with herniated nucleus pulposus at the L4-5 interspace, only 138 had demonstrable sensory changes. Of these, 21 had sensory diminution involving the posterolateral aspect of the thigh and/or the calf; 51 had involvement of the posterolateral aspect of the thigh and/or the calf plus the dorsolateral aspect of the foot, while in 13 patients it was limited

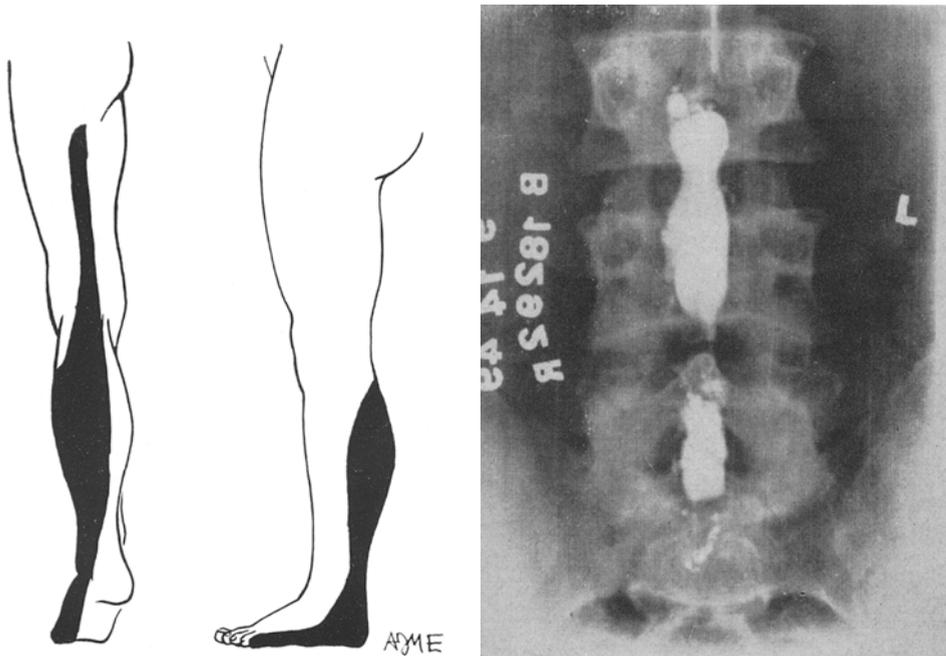


FIG. 3. Although the sensory changes would seem to indicate a herniation of the nucleus pulposus at the L5-S1 interspace (1st sacral root), myelography showed the lesion to be at the L4-5 interspace. This was later verified at surgery.

to the dorsolateral aspect of the foot only. Seven patients had sensory changes on the anterior aspect of the thigh, leg and/or the dorsum of the foot, and 6 had involvement of the entire thigh, calf and/or foot. Five had bilateral involvement. The sensory changes in the remaining 37 patients were evenly distributed between other miscellaneous areas and did not fall into any of the categories mentioned above. No typical sensory pattern could be demonstrated for herniations at the L4-5 interspace. In fact, the sensory changes were often misleading. For example, one patient had hypesthesia and hypalgesia extending in a narrow band along the posterior aspect of the thigh, the posterolateral aspect of the calf and the lateral aspect of the foot, including the little toe, corresponding most closely to the diagnosis of a herniation at the L5-S1 interspace, involving the posterior root of the 1st

sacral nerve, according to Keegan's dermatome chart and to the conception of many investigators. Yet, myelography revealed an almost complete block at the L4-5 interspace, and at surgery a herniation of the nucleus pulposus between the 4th and 5th lumbar vertebrae was found (Fig. 3).

Likewise, herniations at the L5-S1 interspace produced no typical pattern, and herniations at these two levels could not be differentiated on the basis of sensory changes alone. Of the 234 patients with herniated nucleus pulposus at the L5-S1 interspace, only 148 had demonstrable sensory changes. Of these, 18 had sensory diminution involving the posterolateral aspect of the thigh and/or the calf, 68 had involvement of the posterolateral aspect of the thigh and/or the calf plus the dorsolateral aspect of the foot, while in 29 patients it was limited to the dorsolateral aspect of the foot only. Three patients had sensory changes on the anterior aspect of the leg and foot, and 4 had involvement of the entire leg and foot. One had bilateral involvement. The sensory changes in the remaining 25 patients were located at various miscellaneous areas.

One patient had a herniated nucleus pulposus at the L1-2 interspace. This was a midline lesion producing sensory changes in both lower extremities. There were 10 patients with herniations at the L3-4 interspace and 5 had sensory changes. Two of these had hypalgesia involving the lateral aspect of the calf; 1, the lateral aspect of the thigh and calf; 1, the posterolateral aspect of the thigh and calf and the dorsolateral aspect of the foot, and 1 had bilateral involvement.

There were 16 patients with a transitional 1st sacral, or 6th lumbar, vertebra and they are considered separately. Fourteen had herniations at the L5-6 interspace. Five of these had no sensory changes, 7 had hypalgesia over the posterolateral aspect of the thigh and calf and/or the dorsolateral aspect of the foot, while 2 had changes limited to the lateral aspect of the foot only. Two patients had herniations at the L6-S1 interspace and both had sensory changes, one over the buttock, the posterior surface of the thigh and calf and the heel, the other over the lateral surface of the leg and dorsolateral aspect of the foot.

There were 20 patients who had multiple herniations verified at surgery: 3 at L3-4 and L4-5; 12 at L4-5 and L5-S1; 2 at L3-4 and L5-S1 and 2 at all three interspaces. Twelve of these patients had sensory changes, 7 having involvement of the posterolateral aspect of the thigh and calf and/or the dorsolateral aspect of the foot; 1, the dorsolateral aspect of the foot only; 2, the medial aspect of the leg and/or the foot; 1 had bilateral sensory changes and 1, the lateral aspect of the calf and medial aspect of the foot.

Of the 18 patients with herniated cervical nucleus pulposus, 12 had sensory changes. One patient had a lesion at the C3-4 interspace and had diminution of pin prick sensibility over the lateral aspect of the arm, forearm and hand. Nine patients had herniations at the C5-6 interspace and 7 of these had sensory changes. Three had hypalgesia on the lateral aspect of the hand and thumb only; 2, on the lateral aspect of the arm, forearm and hand;

1, on the lateral aspect of the forearm only, and 1, on the dorsal aspect of the arm and volar surface of the hand. There were 7 patients with herniated nucleus pulposus at the C6-7 interspace, and 3 of these had sensory changes:

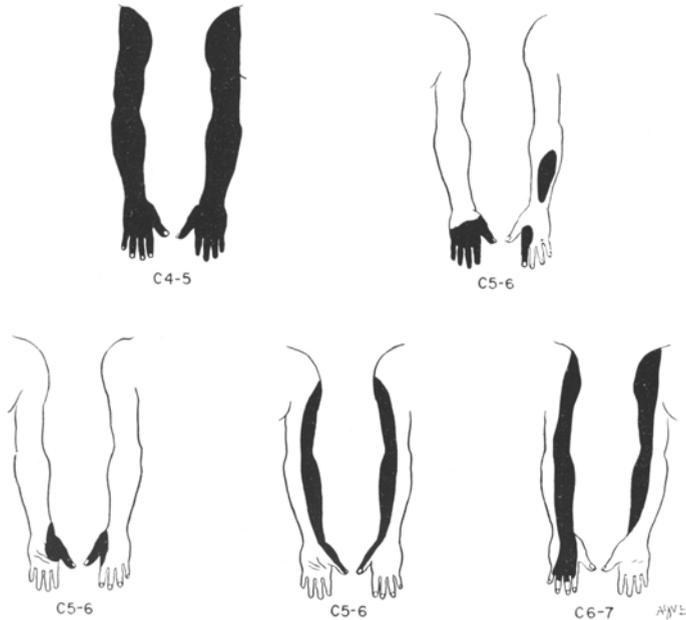


FIG. 4. Some of the variety of sensory patterns accompanying herniations of the nucleus pulposus at the cervical levels.

2 at the fingertips only and 1 on the lateral aspect of the arm, forearm and hand. Some of the sensory patterns with herniated cervical nucleus pulposus are shown in Fig. 4.

The extreme variability of sensory changes with herniated nucleus pulposus is readily understandable when one considers the fact that the lesions are almost never the same size or shape, nor in the same location, and may involve part of a posterior spinal root, an entire root, or more than one root, or may involve a root higher or lower than one would expect. Therefore, it appears to us not feasible to attempt to chart dermatomes from the study of patients with herniated nucleus pulposus.

With Keegan's scratch method, it was found that the sensory change was appreciated a little later than with pin prick, so that when the scratch was made from the hypalgesic area to the normal

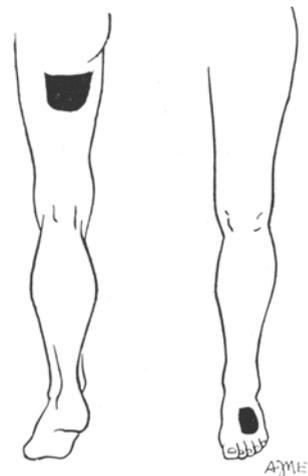


FIG. 5. Areas of sensory diminution after section of the 1st sacral root.

area, the extent of diminished sensation appeared to be slightly greater. However, it was not possible to demonstrate a narrow band of hypalgesia extending from the spine to the distal end of the extremity, as described by Keegan. In fact over half (198) of the patients with sensory changes had involvement of the distal part of the extremity only with no demonstrable sensory loss in the proximal portion.

Our experience with section of a single posterior spinal root in the lumbosacral area is limited. A patient who had a neurofibroma of the 1st sacral roots had a division of the roots to remove the tumor and the only demonstrable sensory changes were slight hypalgesia over the posterior aspect of the upper thigh and a small area of hypalgesia on the dorsum of the foot (Fig. 5). This is explained undoubtedly by a sensory overlap of adjacent uninjured posterior spinal roots.

#### SUMMARY

Sensory changes in 500 patients with herniated nucleus pulposus showed no correlation between the sensory pattern and the level of the lesion. The extreme variability in the sensory pattern makes the method of devising a dermatome chart from the sensory changes in patients with herniated nucleus pulposus an unreliable one. While myelography is not necessary to establish the diagnosis of a herniated nucleus pulposus, we believe it is the most reliable method of localizing the lesion in the lumbar spine.

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