

FOERSTER'S SCHEME OF THE DERMATOMES

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According to the painstaking researches of Prof. Otfried Foerster, of the University of Breslau, Germany, the innervation of the skin by the spinal nerves is not accurately set forth in standard textbooks of neurology. This investigator has had as one of his projects for many years the study of the segmental innervation of the skin. Since the expanded results of his work¹ are not readily available, permission has been granted me to summarize and republish them.

There are several methods of determining the distribution in the skin of the spinal nerves:

1. Dissection. An individual root may be followed by anatomic dissection from a ganglion, through a plexus if necessary, to the ends of the fine branches in the skin.

2. Isolation. Roots above and below that at the level to be investigated may be divided, only the cutaneous representation of the selected root being left to be determined by test.

3. Irritation. Herpes zoster, commonly believed to follow inflammation of ganglia of the posterior roots, produces eruptions in the skin of corresponding areas. Since the process often is limited to a single segment, the distribution of the eruption may be related to definite levels in the spinal cord. Under this heading should come faradic stimulation of the distal remnant of a divided posterior root, by which are produced vasodilatation and consequent demarcation of the affected skin that may be recorded.

4. "Constructive Method." If one sections the tenth, eleventh and twelfth thoracic roots, sensory examination will show the highest level of innervation of the skin by the first lumbar segment. If in another patient one sections the second, third and fourth lumbar roots, one may determine the lower limit of the area of skin innervated by the first lumbar segment. The delineation of the average extent of the single segments by this method is practicable when there is a considerable material at hand.

The laborious method of dissection was employed by Herringham and after him by Bolk. It yielded results that appear to be accurate

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1. Foerster, O., in Bumke, O., and Foerster, O.: *Handbuch der Neurologie*, Berlin, Julius Springer, 1936.

in regard to shape and position. The dermatomes outlined thus have not, however, the extent that other investigations have shown them to have. The method shows little or no overlap of contiguous segments. There seems little doubt that this is due to the impossibility of following minute filaments to their eventual terminations.

The method of isolation probably is the most dependable of those listed. Before Foerster reported his work with this method the diligent investigations of Sherrington² had produced a better understanding of segmental innervation. Sherrington worked with cats and monkeys. From his research came several generalizations applicable to man:

1. The field of each sensory root overlaps those of adjacent roots.
2. Section of a single root does not result in any anesthesia.
3. "Although in the plexuses associated with the innervation of the extremities each segmental nerve contributes sensory fibers to two or more peripheral nerves, the cutaneous distribution of these fibers is not composed of disjointed patches, but forms a continuous field."

Head,³ through his study of a large number of cases of herpes zoster, gave the most accurate charts of the dermatomes in man before those of Foerster appeared. His work took into account cases of lesions of the cord and cauda equina, as well as the charting of hyperesthetic areas in visceral disease.

In his scheme (fig. 1) little overlap appeared. The question that arose was whether the discrepancies between Sherrington's findings for the monkey and the situation for man were real or depended on the method of study.

The Committee upon Injuries of the Nervous System of the Medical Research Council,⁴ in summarizing the experience of the British during the World War with wounds of the spinal cord and cauda equina, published good charts of sensory levels. Apparently it was not possible to determine the exact levels of injury in all cases, and in regard to cervical and thoracic dermatomes the levels arrived at by the British workers and by Foerster disagreed. There was, however, a striking agreement in respect to the configurations of the caudal margins of the dermatomes.

Foerster in attacking the problem used three of the methods mentioned: isolation ("remaining sensibility"), the constructive method

2. Sherrington, C. S.: *Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of Some Spinal Nerves*, Phil. Tr., London, s.B **184**:641, 1894.

3. Head, H., and Campbell, A. W.: *The Pathology of Herpes Zoster and Its Bearing on Sensory Localization*, Brain **23**:353, 1900.

4. *Injuries of the Spinal Cord and Cauda Equina*, Reports of the Committee upon Injuries of the Nervous System, Medical Research Council, Special Report Series, no. 88, London, His Majesty's Stationery Office, 1924.

and irritation in the form of faradic stimulation of the posterior roots. Results obtained by stimulation agreed in general with those obtained by the first two methods, but gave smaller areas—areas that correspond to those noted by Head in cases of herpetic eruption. More important conclusions came from isolation and the constructive method.

In caring for a tremendous neurosurgical practice, Foerster had numerous occasions for division of posterior roots. Resulting areas of anesthesia and remaining sensibility were carefully recorded. These

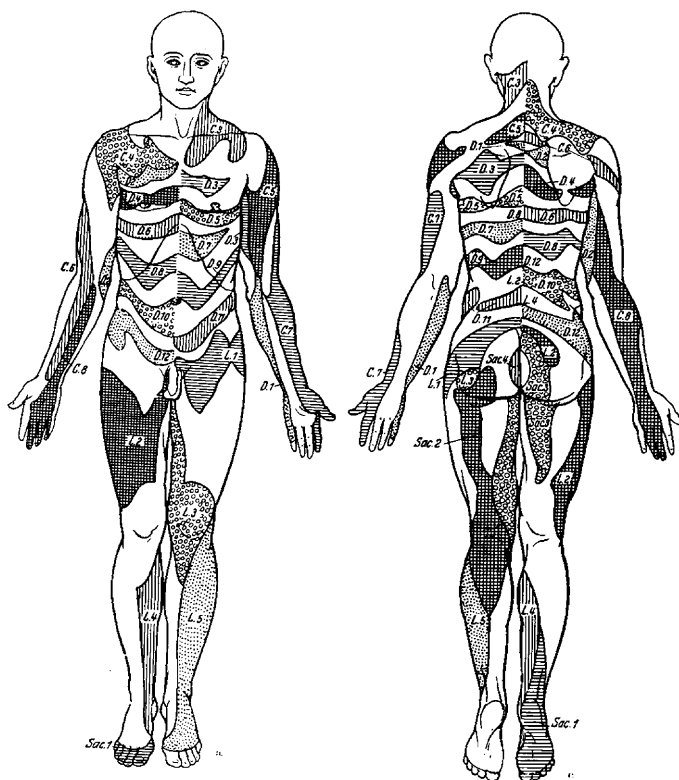


Fig. 1.—The dermatomes in man, according to Head.

records have been presented in more than ninety photographs, which are here summarized in figures 2 to 5. The areas presented are averages; analgesia has been considered to be of major importance, but the boundaries for anesthesia and thermesthesia usually showed slight deviation. The seventh cervical dermatome, which does not appear in the charts, begins lower on the upper part of the arm than the sixth and includes most or all of the hand. The third, the fourth and the fifth sacral dermatome overlap at the anus and about the genitalia.

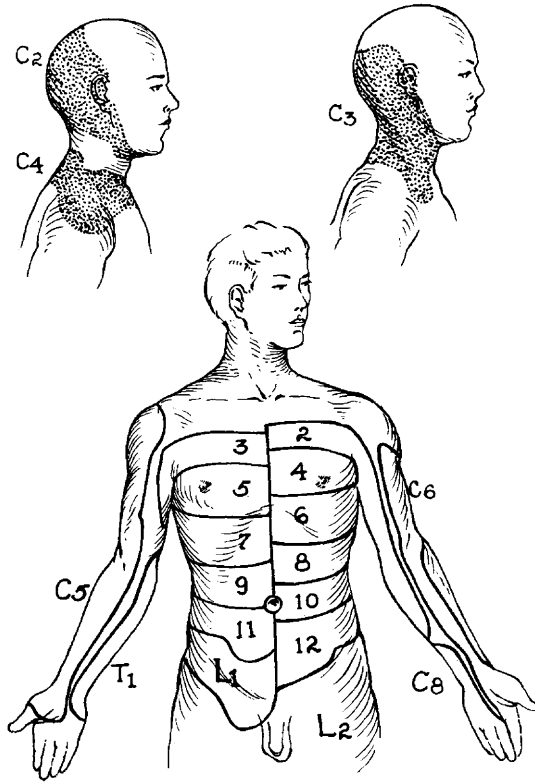


Fig. 2.—Scheme of the cervical and thoracic dermatomes, after Foerster. *C*, *T* and *L* refer to the cervical, thoracic and lumbar; the numbers indicate segments.

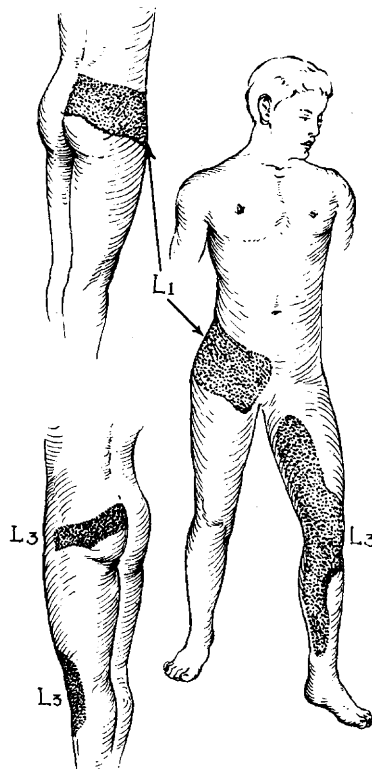


Fig. 3.—The first (*L1*) and the third (*L3*) lumbar dermatome, after Foerster.

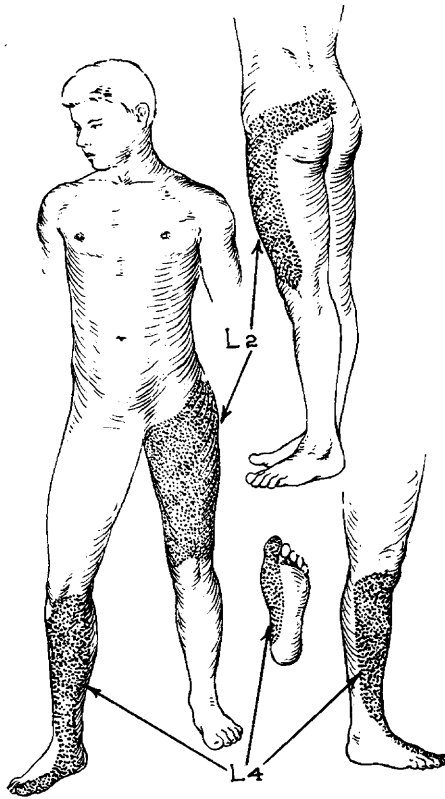


Fig. 4.—The second (*L2*) and the fourth (*L4*) lumbar dermatome, after Foerster.

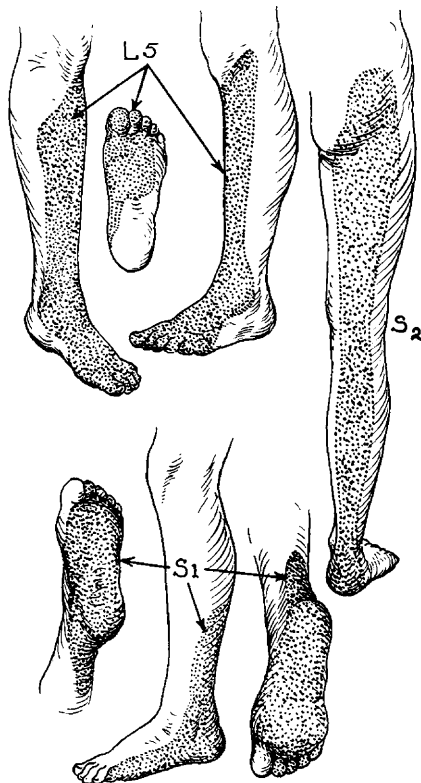


Fig. 5.—The fifth lumbar (*L5*) and the first and second sacral (*S1* and *S2*, respectively) dermatome, after Foerster.

Several points in regard to the use of the scheme may be mentioned briefly: 1. No anesthesia will be found on examination unless two or more segments are physiologically incapacitated. This fact, long recognized, apparently needs reiteration from time to time. 2. Lesions that produce isolated segmental anesthesia, with intact segments above and below, are extremely rare; when they are present, however, the affected segments will be identified by recognition of the lower margin of the uppermost and the upper margin of the lowermost functioning level. 3. The major use of this scheme is in the recognition of a level below which sensory function of the skin is abolished, as met in cases of tumor or injury of the spinal cord. In such cases the configuration of the caudal margin of one of the dermatomes here presented will be found to give the identity of the highest functioning segment.

After some experience with it, Foerster's scheme is believed to be satisfactory. It is recommended to practitioners who have been annoyed to find, after careful sensory examination in cases of segmental sensory disturbance, that their findings have no significance according to conventional charts of innervation.