ANASTOMOSES BETWEEN CERVICAL NERVE ROOTS*
HENRY G. SCHWARTZ, M.D.
Division of Neurological Surgery, Department of Surgery, Washington University Medical School, St. Louis, Missouri
(Received for publication January 20, 1956)

The distribution of subjective pain and objective sensory disturbance caused by cervical root involvement frequently has been noted to deviate from the "normal" dermatome pattern. Although variation from the normal may be explained on the basis of pre- or post-fixation of the brachial plexus and by peripheral overlap, recent experience has led us to consider another possibility.

In the course of performing posterior rhizotomy for relief of limited pain in the hand we have had a patient in whom slender anastomotic branches were found running from the dural margin of the 7th posterior cervical root to join the 6th cervical root centrally. Under local anesthesia, stimulation of the anastomotic rootlet produced discrete pain in the thumb and thenar eminence. Stimulation of the 7th root, which this branch accompanied peripherally, produced pain in the index finger. In another patient, with pain in the ulnar aspect of the hand, an anastomotic ramus from C8 to T1 was found and had to be cut along with the C8 rootlets to effectively abolish pain.

In two patients with cervical disc herniation, discrepancy between sclerotome and dermatome levels could not be explained on the basis of anomalous fixation of the plexus. Intrathecal exploration revealed compression of a rootlet running centrally to join the posterior root at the next segment. Similar anastomoses of the upper cervical nerves have been found frequently in the course of operations for high cervical cordotomy.

These experiences therefore have led us to consider the role of intrathecal anastomoses between the cervical posterior roots as an additional factor to explain variations from "normal" dermatome patterns. Observations made in anatomical dissections will be presented.

OBSERVATIONS

The cervical spines of 13 adult human subjects were dissected and the findings are diagrammatically represented in Fig. 1. Anastomotic rami from the peripheral portion of one sensory root to the central portion of an adjacent sensory root were found in all cases. Frequency varied from a solitary connection between C6 and C5 on one side in one subject, to a maximum

of six anastomotic rami involving various roots on both sides in two subjects. Of the 12 subjects with multiple anastomoses, approximate bilateral symmetry was noted in only one, with branches from C7 to C6, and T1 to C8 on both sides; in this case, additional rami were found between C5 and C4 on the left and C4 and C3 on the right. The most frequent communications in this group of dissections were between C7 and C6. It was noted that the majority of anastomoses appeared to arise from the ganglion of the nerve below to enter the cord with the posterior root fibres of the next rostral nerve. Far less commonly did the branch enter with the root below. None of the anastomoses in these specimens extended farther than one segment; however, we have found one connection between C6 and C4 at operation in one patient.

**DISCUSSION**

The anatomic observations made in this small series of cadaver dissections indicate that intrathecal anastomotic connections between the posterior roots occur quite commonly in the cervical region. Since our dissections were confined to the neck, it cannot be said whether or not they occur similarly in the lower portions of the spinal axis. The ground structure exists embryologically to permit such anastomoses to occur throughout the spine. In the human embryo, Streeter observed that, by the 20th day, the ganglion crest of the hindbrain and spinal cord divides longitudinally into right and left halves. Projecting ventrally from the dorsal bridge are the primitive spinal ganglia (Fig. 2A). At 4 weeks, the dorsal border of the spinal crest still forms a continuous bridge along the tops of the primitive ganglia throughout the length of the spinal cord (Fig. 2B). The dorsal roots are much slower to develop than are the ventral roots, and the ganglionic masses do not begin to separate until about 30 days. The interganglionic ridge disappears at the end of the 5th week (Fig. 2C). At this time, as Streeter puts it, "one gets the impression of an actual conversion of the dorsal bridge into the ganglion rootlets." These rootlets increase in length and show a tendency toward anastomosis.” Streeter’s reconstruction of a 6-week human embryo shows anastomosis between C3 and C4 dorsal roots (Fig. 2D).