DERMATOME HYPALGESIA WITH POSTEROLATERAL HERNIATION OF LOWER CERVICAL INTERVERTEBRAL DISC

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The clinical syndrome of nerve root compression by posterolateral herniation of a lower cervical intervertebral disc has been well presented in recent articles by Semmes and Murphey,16 Ulmer and Meredith,20 Spurling and Scoville,18 Michelsen and Mixter,19 Bucy and Chenault,2 Elliott and Kremer,1 Bradford and Spurling,1 Young,21 Eaton,3 and Murphey and Meade.14 It has been brought to attention by these authors that pain which extends from the lower cervical spine over the upper scapula and down the arm, often with associated numb sensation in some part of the hand, commonly is caused by lower cervical disc herniation. Formerly this syndrome has been variously diagnosed as brachial neuritis, radiculitis, fibrositis, myalgia or reflex pain, with focal infection, cervical arthritis, acromial bursitis, cervical rib, scalenus anticus, cardiac or gall bladder disease often suspected in etiology. Now it is necessary to re-evaluate this type of pain and recognize that it more often is due to nerve root compression by herniation of a lower cervical intervertebral disc. Our present state of knowledge of this herniation is at the same stage as that of herniation of a lower lumbar disc ten years ago when the diagnosis of sciatic neuritis was in vogue, with many hypothetical explanations of its cause, now discarded.

The cervical spine and the lumbar spine are similar in their mobility, with frequent forward-bending strain placed upon them and occasional fracture or dislocation in these regions from violent force. In the lumbar region heavy weight bearing on a poor mechanical angle with the sacrum is the most important factor in causation of posterolateral herniation of the nucleus pulposus of the 5th, 4th and 3rd lumbar intervertebral discs, in this order of frequency, whereas fracture-dislocation and hypertrophic arthritis occur more frequently in the upper lumbar region. In the cervical spine similar stress and strain frequently lead to narrowing and border hyperostosis of the lower cervical intervertebral discs, commonly seen in roentgenograms, and at this same site fracture-dislocation usually occurs, indicating that this is the site of greatest combined strain in the neck.

Recognition that pathology of the lower cervical discs produces nerve root symptoms has antedated recognition of discrete posterolateral cervical disc herniation, just as other pathology in the lumbar spine was previously used to explain nerve root compression symptoms of disc herniation there. Oppenheimer and Turner15 have written extensively of what they have
termed “discogenetic disease of the cervical spine with segmental neuritis,” relating the nerve root pain to narrowing of the intervertebral canal by adjacent vertebral border hyperostosis. This very nearly explained the mechanism involved, but they did not recognize that the commonest primary cause of this hyperostosis and “segmental neuritis” was posterolateral herniation of the intervertebral disc.

The early writings on cervical disc herniation pertained more to larger midline or transverse herniation into the spinal canal causing spinal cord compression (Stookey19), just as such reports of occasional large herniations in the lumbar region preceded recognition of the more common posterolateral discrete nucleus herniation there. The important difference between these two types of herniation is that in the lateral small nucleus herniation a single nerve root is compressed on only one side, giving rise to distinctly lateralized radiating nerve root pain and associated numb sensation which are located accurately in the distribution of that nerve root. This localized nerve root pain and hypalgesia have been shown by the author9,10,11 to be diagnostic of the site of disc herniation in the lumbar region, where the sensory distribu-

Fig. 1. Dermatome chart of the upper extremity determined by outlining the area of hypalgesia found with single nerve root loss in the lower cervical region.
tion or primary dermatome hypalgesia pattern for each nerve root has been outlined in a large series of surgically verified cases and a new dermatome chart for the lower extremity presented. Similarly in the upper extremity it will be brought to attention in this paper that a definite dermatome hypalgesia pattern can be outlined for each of the 6th, 7th and 8th cervical nerve roots commonly involved by compression of a lower cervical intervertebral disc herniation, with added evidence of the dermatome distribution of the 4th and 5th cervical and 1st thoracic nerve roots (Fig. 1).

Reference to the literature on single nerve root dermatome areas in the extremities is very confusing due to the great variety of standard dermatome charts used for illustration and the prevailing conceptions that loss of a single nerve root produces no loss of sensation and that some sensory dermatomes are represented only in the distal region of the extremity as shown by Foerster (Fig. 2). This subject has been discussed briefly in preceding articles dealing with the dermatomes of the lower extremity (Keegan), and will be presented in more detail in a forthcoming article in conjunction with Dr. Frederic D. Garrett of the Department of Anatomy. The chief point to be stressed here is that definite areas of dermatome hypalgesia for single nerve root loss can be found by use of a comparatively simple technique by anyone who will test for them carefully and correctly, and that they occur as diagnostic patterns in the upper extremity as well as in the lower extremity.

The technique of this outlining of a dermatome area of faint reduction of pain sensation is quite simple and easy but, judging from the difficulty of others in finding these diagnostic areas of hypalgesia, requires some attention to detail and an appreciation of rather slightly differing degrees of pain sensation not detected by the ordinary pin stick. The best method is
to very lightly draw the nearly vertical pin point over the skin in such manner that the patient does not complain of disagreeable pain in the region under study. He states that the pin feels sharp but is not painful and there is no tendency to withdrawal or complaint because of pain reaction. The degree of pressure varies with individual patients and according to skin thickness in different regions. Some patients are so pain sensitive or reactive that very light pin touch seems disagreeable and leads to withdrawal, while others are so insensitive or unresponsive that they will not easily make fine distinction of differing degrees of pain. This usually can be overcome by explanation to the patient and gaining his cooperation. Testing by pin stick is less reliable than pin scratch because of the varying penetration of the pin point, with too painful reaction, and lack of continuity of the stimulus. Likewise touch sensation cannot be used reliably because of its faint stimulus which varies too much with thickness of skin and the presence of hairs. Temperature sensation by ice tube can be used reliably but is not as convenient nor as sharply differentiated as the pain sensation of light pin scratch. A medium-sized safety pin opened to a right angle permits good hand control, except at projecting bone borders or tendon ridges. It is difficult to delimit areas of hypalgesia accurately on the fingers or toes because of the lack of continuity of the pin scratch.

The first procedure in detecting an area of single nerve root involvement is to obtain from the patient an accurate description or indication of the location of the radiating pain or numb sensation. Too often in the past the examiner has been satisfied with the gross description of “down the leg or arm” or has accepted the patient’s diagnosis of “in the hip joint and sciatic nerve,” “in the shoulder and arm,” often omitting an earlier location and sequence which relates the onset of trouble to the spine. If asked, the patient usually will indicate a more exact distribution of the radiating nerve root pain, and will locate the subjective numbness in one or two fingers or toes. Testing this accurately located area of pain radiation or numbness by light pin scratch and comparing it with adjoining areas often will register the response of “not quite so sharp” in the involved area. But even where this differentiation is not present, drawing the pin lightly from the suspected area around the arm or leg usually will elicit a very definite and constant reaction of increased sharpness when the normal skin area is entered. Frequently the patient tends towards withdrawal at this transition line or accuses the examiner of pressing harder.

It should be emphasized that the dermatome areas thus outlined, which do not seem to overlap significantly, are areas of detectable hypalgesia from single nerve root loss and probably represent the primary innervation, not the entire distribution of each nerve root. In agreement with Foerster, there must be considerable secondary overlap innervation for each nerve root, otherwise analgesia in the primary area would be found with single nerve root loss. In fact, at times a very faint paralleling strip of hypalgesia can be found on each side of the primary dermatome hypalgesia by the light pin scratch technique, about half the width of the primary zone. This greater overlap innervation probably accounts for the tendency of subjective “asleep” sensation or paresthesia to extend beyond the primary dermatome hypalgesia area.

The writers on posterolateral cervical disc herniation thus far seem to have had difficulty outlining consistent areas of sensory reduction in the arm and hand in their reported cases. Semmes and Murphey, reporting 4 cases of compression of the 7th cervical nerve root, found “pronounced hypesthesia and hypalgesia over the entire index finger, extending to the metacarpophalangeal joint, with slight reduction of sensation in the middle finger in 3 cases, also weakness in flexion of the index finger.” Ulmer and
Meredith, in 2 cases of 8th cervical nerve root compression, described hypesthesia over the ulnar border of the left hand including the little, ring and middle fingers in one case, but only subjective prickly feeling of the little, ring and middle fingers in the other case. Spurling and Scoville reported 12 cases of lateral rupture of the cervical intervertebral discs, in 11 of which there was subjective numbness, with objective sensory loss in 9 of these: 3 of the 6th root, 5 of the 7th root and 1 of both 6th and 7th roots. They presented a chart representing these areas of sensory disturbance for the 6th and 7th cervical nerve roots. Michelsen and Mixter, reporting 8 cases, found impairment of sensation in some parts of the upper extremity in 7. "There was involvement of the scapula, the anterolateral aspect of the upper arm, the antecubital space, the radial side of the forearm and the thumb and index finger" with compression of the 6th cervical root. "The scapula, the dorso-lateral aspect of the upper arm, the dorsal aspect of the forearm and the index and middle fingers were affected by compression of the 7th cervical root." Compression of the 8th cervical root "produced sensory abnormalities of the scapula, the inner side of the upper arm and forearm and the little finger." No chart representing these areas was shown but comparison was made with Foerster's chart of the distribution of the cervical dermatomes (Fig. 2), with the statement that "one also may infer that the areas in which this pain and the other sensory abnormalities occurred represented the dermatomes supplied by the affected posterior roots." Bucy and Chenault, in a case of 7th cervical nerve root compression, found "an area of hypalgesia, hypesthesia and hypothermesthesia over the right thumb and the index and middle fingers and on the radial border of the forearm, as shown in the illustration." Murphey and Meade reported that "with compression of the 6th cervical nerve root, numbness and hypesthesia on the lateral aspect of the forearm and thumb and index finger may be present. With compression of the 7th cervical nerve root, there may be hypesthesia of the index and middle fingers." From these reports it is evident that there is fairly consistent finding of areas of sensory reduction with compression of a single lower cervical nerve root by posterolateral herniation of a cervical intervertebral disc, contrary to Foerster's statement that "division of a single nerve root produces no loss of sensibility." There now is similar near agreement that this statement is not true in reference to the lower extremity and it seems time that it be disregarded. Also, it is noteworthy that Michelsen and Mixter reported sensory disturbance over the scapula and upper arm in most of their cases and found difficulty harmonizing this location with Foerster's dermatome chart (Fig. 2).

Applying the light pin scratch technique described earlier in this paper, the author has been able to find and outline a definite dermatome area of hypalgesia for each of the 4th, 5th, 6th, 7th, and 8th cervical nerve roots in 51 clinical cases with history indicative of herniation of lower cervical intervertebral disc, with added anterior primary division of the 1st thoracic nerve root in 10 cases of cervical rib or scalenus anticus syndrome (Fig. 1 and Table
1). Selected case reports from this series with photographs of the areas plotted are presented, with surgical verification of the lesion in 13 cases. This has been confirmed further by similar findings in X-ray controlled novocaine injection of individual nerve roots in 10 medical student volunteers,* which will be reported in more detail in a separate paper.

**TABLE 1**

*Clinical cases and student injections showing single nerve root dermatome hypalgesia*

<table>
<thead>
<tr>
<th>Dermatome</th>
<th>Cases</th>
<th>Students</th>
<th>Total</th>
<th>Operation</th>
<th>Verified</th>
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<td>1</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
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<td>6</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
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<td>9</td>
<td>2</td>
<td>11</td>
<td>5</td>
<td>7</td>
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<tr>
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<td>14</td>
<td>3</td>
<td>17</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
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<td>2</td>
<td>10</td>
<td>2</td>
<td>4</td>
</tr>
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<td>10</td>
<td>69</td>
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**DISCUSSION**

Although not all of the clinical cases upon which this report is based have been proven by operation as to nerve root involved, they do show consistently similar areas of dermatome hypalgesia distribution for each nerve root, in 4 cases for the 4th cervical, 7 cases for the 5th cervical, 11 cases for the 6th cervical, 20 cases for the 7th cervical, 17 cases for the 8th cervical and 8 cases for the 1st thoracic nerve root, with surgical verification of the lesion for each of the 6th, 7th, and 8th cervical and 1st thoracic nerve roots. The histories of the clinical cases all are so similar and characteristic of the now recognized syndromes of lower cervical nerve root compression by posterolateral cervical disc herniation and lower brachial cord compression by cervical rib or scalenus anticus muscle that it seems fair to assume that they represent lesions of this type.

The most distinguishing symptom of the lower cervical nerve root syndrome, to differentiate it from brachial plexus and peripheral nerve syndromes, is the location of early pain over the upper medial scapular region associated with neck movement. This scapular pain is comparable to the rather constant "hip" or gluteal pain found associated with lumbar disc herniations, interpreted by the author\textsuperscript{11} as due to early contact of the most posteriorly situated fibers of the posterior primary division of the nerve root against the ligamentum flavum or lamina as the root is displaced posteriorly by the herniation. Upper medial scapular pain should not be present when pressure or pathology is located lower down on the brachial plexus, as with cervical rib or scalenus anticus compression of the lower primary cord, and the hypalgesia distribution would be different. This is illustrated by Case

No. T1-1, a typical example of bilateral scalenus anticus syndrome with cervical ribs. In this case the area of hypalgesia plotted includes the anterior primary division of two roots, the 8th cervical and 1st thoracic, extending posteriorly only to the outer border of the scapula and anteriorly into the infraclavicular region, with a wider total area along the anteromedial surface of the arm than for the 8th cervical nerve root alone (Fig. 10). Another example of this hypalgesia pattern is Case No. C6-3, with the scalenus syndrome probably secondary to 6th cervical nerve root compression by herniation of the underlying intervertebral disc. Another interesting feature of this scapular pain with cervical disc herniation is that it frequently has been misinterpreted as reflex gall bladder pain, depending on the side on which it is located. It might be called to attention that reflex pain from gall bladder disease is located at the lower angle of the scapula, which is in the 8th thoracic segmental level of the gall bladder innervation, not the upper region of the scapula where lower cervical root pain is referred. Visceral reflex pain cannot leave the peripheral distribution of the segmental innervation of the organ from which it arises, nor can it have any peripheral manifestation other than pain and hypalgesia (Lewis16).

Josey and Murphey8 have emphasized the occurrence of anterior pectoral pain which in some cases of cervical disc herniation is easily confused with cardiac angina. Although this symptom was found in only 3 cases, No. C7-9, C7-10 and C7-11, and then not characteristically in the author's series, it undoubtedly does occur and herniation of a cervical disc should be considered in cases of suspected cardiac angina without clearly demonstrated cardiac pathology. The presence of subjective numbness or objective hypalgesia in the arm, in distinction from pain radiation, should rule out a reflex phenomenon from the heart.

Another symptom necessitating cervical location of the pathology in shoulder and arm syndromes is the definite tenderness to pressure over involved cervical vertebrae, particularly when pressure over the transverse process or ligamentum flavum of one side produces pain or tingling sensation which radiates down the arm, or when downward pressure on the head towards the side of the lesion sends radiating pain or tingling sensation into the arm in characteristic nerve root distribution.

Identification of the single nerve root involved by posterolateral cervical disc herniation is based chiefly on the appreciable loss of sensation, both subjectively and objectively, which can be found in these cases, although the distribution of the radiating shoulder and arm pain is of some value in identifying the nerve root involved if the patient is asked to trace the course of the pain accurately. The most definite loss of sensation occurs in the hand, particularly in the fingers or thumb, consistent with the recognized greater representation of some arm dermatomes in the distal region of the extremity. However, the patient often will detect subjectively a "different," "asleep" feeling which extends up the arm to the deltoid region or beyond, accurately placed in the skin distribution of the compressed nerve root. The best identi-
fication of this sensory loss or reduction is by testing with light pin scratch as explained in the first part of this paper. Then the area of subjective numb or "asleep" sensation becomes sharply defined as a continuous strip of hypalgesia extending in constant location from the most involved fingers or thumb, in lesser but definite degree up the arm and over the shoulder to the lower cervical spine. In this manner the dermatome hypalgesia area for each of the 4th, 5th, 6th, 7th, 8th cervical and 1st thoracic nerve roots has been found in 69 cases (Fig. 1 and Table 1).

This finding of a definite area of reduced sensation from single nerve root compression, stretching or section which extends continuously from the most distal region of the extremity to the spine is contrary to the general conception of sensory nerve root representation in the extremity (Sherrington, Head, Foerster). The most illuminating evidence that detectable sensory and motor loss does occur in the arm from single nerve root loss is found in 2 clinical cases presented in this paper, No. C7-1 and No. C8-1, which are well worth reading by those who are inclined not to read detailed case reports. In Case No. C7-1 (see Fig. 6) the dermatome areas for both the 7th and 6th cervical nerve roots were demonstrated and established by operation. The 7th root loss occurred primarily from discrete nucleus herniation beneath this root, while the 6th root loss was produced by traction on this root during operation. This misplaced traction led to postoperative subjective numbness of the thumb, which was added to the preoperative numbness of the index and middle fingers. But more disturbing than this was the marked motor weakness thus produced in the arm from functional loss of two nerve roots, which emphasizes the necessity of considerable care and skill in doing such an operation to avoid this paralysis. Fortunately such a stretched nerve root will regain its motor function, either rapidly if slight damage is done or by slow regeneration if the damage is great enough to interrupt the axis cylinders. However, there is some question if sensory axis cylinder interruption at this preganglionic site on the nerve root ever will regenerate, due to lack of nerve sheath to follow in the proximal central nervous system (Young).

The second clinical case report worthy of careful study is No. C8-1 (see Fig. 8). This man developed isolated 8th cervical nerve root compression, proven by operation, and with this there not only was definite subjective and objective sensory loss of 8th cervical dermatome distribution, but also quite evident motor loss and atrophy of the small muscles of the hand. Cases like this surely disprove the common statement originally made by Foerster that "division of a single nerve root produces no loss of sensibility." Another significant observation in connection with this case is the necessary differentiation from the scalenus anticus syndrome of compression of the lower primary cord of the brachial plexus, or from the common ulnar nerve involvement at the elbow, both of which produce numb sensation and sensory loss in the little and ring fingers, also atrophy of the small muscles of the hand. As emphasized earlier, the presence of pain over the upper medial
scapula in the cervical root syndrome best distinguishes it from the other two, although tracing of the sensory dermatome of hypalgesia over the scapula in the distribution of the posterior primary division of the involved nerve root would rule out brachial plexus or peripheral nerve lesion.

The value of this finding and recognition of a diagnostic dermatome hypalgesia pattern for single nerve root identification is considerable, both in clinical neurology and neuro-anatomy. Using this technique it is possible to localize the single nerve root involved by posterolateral herniation of an intervertebral disc more accurately than by use of the complicated spinogram. Also the single nerve root syndrome is so constant and definite in these cases that there seems little warrant for the spinogram or claiming multiple nerve root involvement or multiple disc herniations based only on a symptomless protrusion of a disc at a different level. Occasionally difficulty is encountered with this method of single nerve root localization by variable number of ribs or transitional types of vertebrae at the lumbosacral junction. However, it has been found that the numerical position of the nerve root is maintained constantly in relation to the total series of vertebrae, counting 7 cervical, 12 thoracic and 5 lumbar regardless of number of ribs or transitional vertebrae. Thus the 5th lumbar nerve root identified by dermatome hypalgesia is found to emerge in a constant position between the 24th and 25th vertebrae of the total series, regardless of anatomical or pathological abnormality seen in X-rays or questionable defects in the spinogram. This evidence will be presented in a forthcoming article dealing with nerve root relations to abnormalities of the lumbar and cervical spine.

The upper level of a spinal cord compression lesion likewise can be localized more accurately by the light pin scratch technique than by pin stick. Thus the faintest hypalgesia can be detected and will identify the segmental level involved at an early time when uncertain localization by other methods makes spinogram seem necessary.

The usefulness of these new dermatome charts of the extremities, determined by detectable hypalgesia from single nerve root loss, is shown in Fig. 3, in which the generally accepted dermatome pattern of the trunk is added to make a complete dermatome chart of the human body. In this chart a logical serial sequence of all the dermatomes extending outward from the spine is shown and should clarify the present confusion in anatomical teaching of the dermatomes.

**SUMMARY**

The clinical syndrome of lower cervical disc herniation now is clearly established and should be recognized as a fairly common cause of pain extending from the lower neck over the scapula and down the arm with numbness of one or more digits of the hand.

Unilateral herniation of a cervical disc compresses only one nerve root and gives rise to detectable sensory and motor loss in the distribution of that root.
Objective reduction of pain sensation or hypalgesia from single nerve root loss can be demonstrated by the technique of light pin scratch and disproves the tenet that loss of a single nerve root produces no loss of sensibility.

Diagnostic dermatome hypalgesia has been found in 51 clinical cases with history indicative of compression of a lower cervical nerve root by herniation of an intervertebral disc, presenting a new primary dermatome pattern for each of the 4th, 5th, 6th, 7th and 8th cervical nerve roots.

Eight clinical cases of cervical rib or scalenus anticus muscle compression of the lower primary cord of the brachial plexus are presented to illustrate the distribution of the anterior primary division of the 1st thoracic and 8th cervical nerve roots, thus presenting a new diagnostic finding for this syndrome.
A most important distinguishing symptom of lower cervical nerve root compression by herniation of an intervertebral disc is the early location of pain over the upper medial scapular region associated with neck movement, indicating posterior primary nerve root division distribution not present in brachial plexus or peripheral nerve lesions.

The presence of subjective and objective numbness or hypalgesia in an extremity is evidence of an organic lesion of a nerve to the extremity and cannot be classified as reflex pain.

Nerve roots, determined by dermatome hypalgesia distributions, maintain a constant position in the total vertebral series, regardless of anatomical variations of vertebrae, and their location in relation to herniation of an intervertebral disc is more reliable than pathology of discs shown by X-ray or spinogram findings.

A new dermatome chart of the human body is presented which should be useful in clinical neurology and anatomical teaching.

**CASE REPORTS**

**FOURTH CERVICAL DERMATOME HYPALGESIA**

*Case No. C4-1.* Mr. G.H., age 50. This man developed a "catch" in his neck following rather forceful chiropractic treatment, variable and with a "pop" sensation at times on movement of his head forward or backward. With this there was pain and tingling over the upper border of the right trapezius muscle, not extending into his arm, relieved lying down.

Examination showed a definite area of slightly reduced pain sensation over the upper border of the right trapezius muscle, extending from the acromion to the midcervical spine and anterior neck. X-rays of cervical spine showed slight irregularity of the anterior vertebral borders adjoining the cervical disc between the 3rd and 4th vertebrae, otherwise normal.

Diagnosis: Right 4th cervical nerve root compression by herniation of intervertebral disc.

*Case No. C4-2.* Mrs. A.M., age 43.

*Case No. C4-3.* Mr. G.D., age 60.

*Student No. C4-1.* Mr. J. L.

**FIFTH CERVICAL DERMATOME HYPALGESIA**

*Case No. C5-1.* Miss J.V., age 17, complained chiefly of right-sided headaches of 2 years' duration following a neck injury, with no shoulder or arm pain or numb sensation and general examination negative. Because some such headaches have seemed to be related to upper cervical spinal pathology, a study was made of this region.

Examination of the right arm showed a faint but fairly definite dermatome strip of hypalgesia on the anterolateral surface, beginning at the wrist and extending over the shoulder to the lower cervical region anteriorly and posteriorly (Fig. 4). This was found on repeated examinations and was supported by X-ray finding of reversal of curvature between the 4th and 5th cervical vertebrae on forward bending.

Diagnosis: Intervertebral disc pathology compressing the right 5th cervical nerve root.

*Case No. C5-2.* Mrs. L.S., age 36.

*Case No. C5-3.* Miss T.Y., age 23.

*Case No. C5-4.* Mrs. P.F., age 32.

*Case No. C5-5.* Mrs. L.O., age 43. Operation.

*Case No. C5-6.* Mrs. L.H., age 26.

*Student No. C5-1.* Mr. H. R.
SIXTH CERVICAL DERMATOME HYPALGESIA

Case No. C6-1. Mrs. L.V., age 37. At operation for characteristic 7th cervical nerve root syndrome (see Case No. C7-1), considerable traction was applied to the left 6th cervical nerve root. After operation the patient complained of added numbness of the left thumb and disturbing motor weakness in left arm, which was not present before operation.

Examination by light pin scratch showed an added strip of reduced pain sensation which included the thumb and extended upward along the anterolateral arm and over the acromion and suprascapular region to the cervical spine, along the anterior border of the previously outlined 7th cervical dermatome hypalgesia (see Fig. 6). Evidently enough traction had been placed on the 6th cervical nerve root to cause its paralysis and, when added to the preceding loss of function of the 7th cervical nerve root, resulted in temporary disturbing motor paralysis in this arm and emphasizes the care necessary in exploration of more than one brachial nerve root.

Diagnosis: Left 6th cervical nerve root paralysis from surgical traction.

Case No. C6-2. Mrs. J.R., age 38, developed pain in her left lower neck with radiation down this arm to the thumb and index finger with numb sensation more in the thumb. The pain was increased by coughing, sneezing or rotation of the neck to the left, or flexion or extension of the neck. Her neck had been injured in an automobile accident a few months previously. Symptoms were not relieved by traction and conservative treatment.

Examination by light pin scratch showed a definite strip of reduced sensation extending from the left thumb up the lateral arm and over the shoulder to the lower cervical spine (Fig. 5). This did not include the index finger but later testing with lighter scratch detected an additional bordering zone of very faint hypalgesia which included the index finger. This was interpreted to represent secondary or overlap nerve root innervation, which occasionally can be outlined with single nerve root loss. X-rays showed a narrowed disc between the 5th and 6th cervical vertebrae with reversed angulation and some vertebral border hyperostosis at this level.

Diagnosis: Left 6th cervical nerve root compression by herniation of intervertebral disc. Surgery was recommended because of long period of disabling pain.

Operation: Left 5th and 6th cervical laminectomy. The left 6th cervical nerve root was
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found flattened and adherent over a definite rather firm herniation of the underlying disc, with no motor response to mechanical stimulation. The left 7th cervical nerve root was explored without traction or trauma and found free, with active motor response.

Case No. C6-3. Mrs. V.E., age 35, developed episodes of pain in her neck, right shoulder and arm, first associated with swimming 6 years previously, with history of a severe backward snap of her neck in an auto accident the year before that. The present attacks of pain come with physical fatigue and become intolerable, described as like a toothache with the nerve exposed. The neck gets stiff and painful over the lower cervical spine. This extends into the right suprascapular muscles, and over the acromion and deltoid to the antecubital region, lo-

![Image]

Fig. 5. Case C6-2. Dermatome hypalgesia of 6th cervical nerve root with fainter overlap distribution.

cated in these areas rather than radiating. No numb sensation has been noted, but some burning sensation in her hand, not well localized. Venous congestion and sweating also have been noted in this hand associated with attacks. Loss of motor control has been indicated by inability to play the piano as before and tendency to drop things with this hand.

Examination by light pin scratch outlined a fairly definite strip of faintly reduced pain sensation which extended from the right thumb up the lateral arm and over the acromion and suprascapular region to the lower cervical spine. Also there was found a similar strip of faint hypalgesia, which included the little and ring fingers and extended up the inner side of the arm to the axilla, where it stopped posteriorly at the lateral border of the scapula and extended anteriorly below the clavicle to the sternum. X-rays of the cervical spine showed narrowing and hyperostosis of the intervertebral disc between the 5th and 6th cervical vertebrae, with definite narrowing of the right 6th cervical intervertebral canal by this hyperostosis.

Diagnosis: Compression of right 6th cervical nerve root by herniation and hyperostosis of intervertebral disc, with secondary right scalenus anticus compression of the inferior primary cord of the brachial plexus, composed of anterior primary divisions of the 8th cervical and 1st thoracic nerve roots.


Progress: Immediately following operation patient noted numbness of right thumb and index finger, more in the thumb, and testing by pin scratch outlined more definite right 6th cervical dermatome hypalgesia than before operation.
Case No. C6-4. Dr. W.R.N., age 49, developed very sharp pain in the right suprascapular region one morning when awakening. This pain continued and later extended over the acromion and down the posterolateral arm into the thumb, with numb sensation noted on the tip of the thumb and occasionally in the 1st finger in lesser extent. The pain was made worse by moving his head and neck or with his arm down. The numbness in the right thumb prevented him from doing his dental work.

Examination by light pin scratch showed a faint but definite strip of reduced pain sensation extending from the thumb up the lateral arm and over the acromion and suprascapular region to the cervical spine.

Diagnosis: Right 6th cervical nerve root compression by herniation of intervertebral disc.

Operation: Decompression of right 6th cervical nerve root over intervertebral disc herniation.

Case No. C6-5. Mr. H.M., age 45, developed rather sudden onset of an “electrical” sensation in the left thumb shortly after jumping out of a chair to answer the telephone. He was not aware of neck injury but the whole arm and shoulder became involved later with radiating pain and tingling sensation which seemed to go out the end of his thumb. This extended from the lower cervical spine over the top of the shoulder down the outer side of the arm to the entire thumb. Elevating or turning his head to the left made the symptoms worse. For a time he could not use his left hand well and tended to drop things.

Examination by light pin scratch showed a strip of definitely reduced pain sensation or hypalgesia which included the entire thumb and was traceable upwards along the lateral border of the forearm and upper arm over the acromion and upper scapula to the lower cervical spine. X-rays of the cervical spine showed some anterior vertebral border hyperostosis around the disc between 5th and 6th vertebrae.

Diagnosis: Left 6th cervical nerve root compression by herniation of intervertebral disc.

Case No. C6-6. Mrs. C.W., age 40, developed pain which extended from the back of her neck into the right shoulder (suprascapular and acromial region) down the outer side of her arm to the thumb, with numb sensation in the thumb and sometimes a slight “funny” sensation in the 1st finger. Movement of her neck sent pain into this arm and pressure over the lower neck caused pain and a “grating” sensation. She had injured her neck in two automobile accidents.

Examination by light pin scratch showed a definite strip of reduced pain sensation which extended from the right thumb up the lateral arm and over the acromion and suprascapular region to the lower cervical spine. There was analgesia on the palmar surface of the end of the thumb and faint hypalgesia could be detected along the outer side of the index finger. Considerable atrophy was found in the supraspinatus, infraspinatus and teres major muscles, not in the deltoid. X-rays showed a narrow disc between the 5th and 6th cervical vertebrae with some surrounding vertebral border hyperostosis.

Diagnosis: Right 6th cervical nerve root compression by herniation of intervertebral disc.

Operation: Decompression of right 6th cervical nerve root over intervertebral disc herniation.

Case No. C6-7. Dr. H.E.H., age 40, developed aching in right anterolateral upper arm at night for 6 to 8 months, extending to forearm and over top of shoulder to the neck, with prickly, “asleep” feeling in thumb. The pain was made worse by use, with soreness in right side of neck and upper shoulder. This arm function seemed impaired, particularly in elevation of arm at shoulder with some prominence of medial border of scapula noted by patient when arm was held straight laterally.

Examination by light pin scratch showed a well defined strip of faintly reduced pain sensation extending from the thumb and radial side of the 1st finger up the lateral arm and over the acromion and supraclavicular region to the lower cervical spine. The right biceps tendon reflex was absent, the left active. X-rays of the cervical spine showed narrowing of the intervertebral disc between the 5th and 6th cervical vertebrae with some bordering hyperostosis.
Diagnosis: Compression of right 6th cervical nerve root by herniation of intervertebral disc, confirmed by operation.

Case No. C6-8. Dr. T.L.H., age 42, developed tingling sensation in his left thumb rather suddenly with severe stiff neck, soon followed by a boring pain in his biceps, with absent biceps tendon reflex. Two months later he noted some pain over his upper left scapula but more pain in the anterolateral arm. Neck traction improved the numbness and pain but he still had tingling sensation in his left thumb.

Examination by light pin scratch outlined a definite strip of faintly reduced pain sensation extending from his left thumb up the anterolateral arm over the shoulder and suprascapular region to the lower cervical spine. X-rays showed narrowing and hyperostosis of the disc between the 5th and 6th cervical vertebrae.

Diagnosis: Compression of left 6th cervical nerve root by herniation of intervertebral disc.

Case No. C6-9. Mr. O.S., age 52.
Student No. C6-1. Mr. L.M.
Student No. C6-2. Mr. R. C.

SEVENTH CERVICAL DERMATOME HYPALGESIA

Case No. C7-1. Mrs. L.V., age 37, developed sudden severe pain in the left upper medial scapular region when she braced her head against the bed and twisted her neck as she was getting out of bed. This pain soon extended over the suprascapular region and acromion and down the posterolateral arm to the wrist, with numb sensation in the first 3 fingers, not in the thumb or little finger. The involved fingers felt cold and paralyzed, more noticeable in the 1st and 2nd fingers and later involving only these 2 fingers, with a noticeable area of numbness extending into the palm of the hand to the wrist. The subjective numb sensation later was noted extending from the first 2 fingers up the posterolateral arm to the deltoid region, detected by a different “feeling” as she rubbed this strip with her right hand as far as she could reach. She could not lie down or turn her neck without increasing the pain.

Examination showed her pacing the floor with intolerable pain in her left shoulder and arm.

Fig. 6. Case C7-1. Dermatome hypalgesia of 7th cervical nerve root with added postoperative 6th cervical hypalgesia from traction.
as described above. Pressure over the left 6th and 7th cervical transverse processes posteriorly
casted pain which radiated down the shoulder and arm. Her characteristic pain also was re-
produced by downward pressure on the head, right lateral flexion of the neck and abduction of
the left arm. Sensory testing by light pin scratch outlined a definite area of reduced pain sen-
sation or hypalgesia which extended from the left index and middle fingers up the postero-
larateral arm and over the suprascapular region to the lower cervical spine (Fig. 6). The finger
hypalgesia extended on the palmar surface of the hand to end in a point at the wrist, corre-
sponding to an area of subjective numbness. The triceps tendon reflex was reduced on this
side; motor power difficult to test because of pain inhibition. X-rays of the cervical spine
showed an old fusion between the bodies of the 5th and 6th cervical vertebrae with anterior
angulation of the spine at this site and near obliteration of this intervertebral disc. The disc
between the 6th and 7th cervical vertebrae appeared normal in width and outline.

Diagnosis: Acute herniation of the nucleus pulposus of the intervertebral disc between the
6th and 7th cervical vertebrae with compression of the left 7th cervical nerve root. The ob-
literate pathology of the disc above this was interpreted as an old lesion not related to
present acute symptoms. Surgery was recommended for relief of intolerable 7th cervical nerve
root pain.

Operation: The left 6th cervical lamina was removed, exploring the left 6th and 7th cervi-
cal nerve roots. The 6th root, mistakenly identified as the 7th, was explored first, and con-
siderable traction was applied to it searching for a herniation on the underlying sclerosed disc.
Correction of identification of vertebrae then was made and an easily removed nucleus pulpo-
sus herniation found beneath the 7th cervical nerve root.

Postoperatively there was immediate satisfactory relief of the left shoulder and arm pain,
but patient complained of added numbness in the thumb which was not present before opera-
tion, and also marked weakness in motor power of this arm at the elbow and shoulder, not
present before operation. Recheck of the area of hypalgesia now showed the added inclusion
of the thumb and a narrow strip up the arm laterally (Fig. 6), interpreted as left 6th cervical
nerve root hypalgesia due to operative traction on this nerve root. There was thus identified in
this patient, beyond much question, the dermatome hypalgesia distribution of both the 7th
and the 6th cervical nerve roots. Satisfactory recovery of motor function occurred during fol-
lowing weeks.

Case No. C7-2. Mrs. R.K., age 40, was awakened with “terrific” pain in her right shoul-
der, located over the spine of the scapula. She had had “cricks” in her neck many times during
the preceding 2 years, usually developing at night with pain located mostly to the right side
of her lower cervical spine. The shoulder pain with this attack was so severe that morphine
had to be given for relief. The pain soon extended down her arm in a definite posterolateral der-
matome strip to the 1st and 2nd fingers, which later felt numb. There was no subjective numb-
ness of the thumb at any time but occasionally slight numb sensation on the radial side of the
3rd finger. The pain gradually subsided during 2 weeks as the numbness of the first 2 fingers
increased. At this time she also noticed weakness in use of her right arm as in combing her hair,
not so noticeable in her hand. The numbness of her fingers persisted, although somewhat vari-
able, with some “stinging” sensation in her 2 fingers with use.

Examination showed no evident atrophy, motor weakness nor reflex loss in her right arm
or hand, but testing by light pin scratch showed a very definite strip of reduced pain sensation
or hypalgesia extending from the 1st and 2nd fingers up the dorsum of the hand and radial
wrist along the posterolateral arm and over the acromion and suprascapular region to the
lower cervical spine (Fig. 7). On the palm this hypalgesia extended in a wedge-shaped area to
the wrist. X-rays of the cervical spine showed a definitely narrowed and immobile disc be-
 tween the 6th and 7th cervical vertebrae with anterior vertebral border hyperostosis around
this disc.

Diagnosis: Right 7th cervical nerve root compression by herniation of intervertebral disc.

Case No. C7-3. Dr. R.L., age 57, injured his neck at age of 18 years diving into shallow
water and since then has been aware of some limitation of neck movement, with occasional
“catch” or “crack” sensation. Pain extended into his right upper scapular region a few years ago when he was practising a golf swing, trying to hold his head still as his shoulders rotated. When he coughed it “felt like his whole shoulder would blow out.” Within a week he developed pain and tingling in his right arm and hand, located chiefly in the first 2 fingers but also in the adjoining borders of the 3rd finger and thumb, the palm and the back of his hand feeling like it was scalded. This was followed by definite numbness in the 1st and 2nd fingers, chiefly in the 1st finger, which could be increased by bringing his head back or turning it to the right. An aching sensation extended along the anterolateral surface of his arm and over his shoulder, associated with an “asleep” sensation in his hand and arm.

Examination by light pin scratch outlined a definite strip of faintly reduced pain sensation which extended from the first 2 fingers over the dorsoradial hand along the lateral arm and

over the acromion and suprascapular region to the lower cervical spine. A wedge-shaped area of hypalgesia was found in the palm. X-rays showed some narrowing and border hyperostosis of the disc between the 6th and 7th cervical vertebrae, with reversal of curvature at this level in the hyperextended position.

Diagnosis: Compression of right 7th cervical nerve root by herniation of intervertebral disc.

Case No. C7-4. Mrs. L.F., age 48, developed sudden very severe pain in the right upper scapular region one night in bed, although for a long time she has had variable pain in the right “shoulder blade” associated with a stiff neck. This time the pain was so severe she could hardly breathe and could not get her head off the pillow. Very soon she noticed that the 1st and 2nd fingers became numb and that this numb sensation extended up the posterolateral arm. The acute pain later was replaced by continuous aching, made worse by movement of her head or arm. After a long automobile ride 3 weeks later she noticed increased pain and numbness. Sneezing and coughing cause shooting pain down the posterolateral arm which “nearly kills” her. The right hand has seemed weak since the onset.

Examination by light pin scratch showed a very definite strip of reduced pain sensation or hypalgesia extending from the first 2 fingers up the dorsum of the hand and posterolateral arm over the acromion and suprascapular region to the lower cervical spine. Also a wedge-shaped area of hypalgesia was found on the palm. Some atrophy and weakness of the supraspinatus, infraspinatus and teres major muscles were noted; no alteration of tendon reflexes.
Diagnosis: Right 7th cervical nerve root compression by herniation of intervertebral disc.

Case No. C7-5. Mr. W.G.K., age 46, developed pain which extended from the lower cervical spine over the right suprascapular region and posterolateral arm, following the drawing of blood for transfusion. This aching continued with some numbness developing in the 1st and 2nd fingers. His shoulder and arm pain was increased by bringing his head backward, so he tended to sit and walk with his head held well forward.

Examination by light pin scratch showed a definite strip of faintly reduced pain sensation extending from the first 2 fingers over the dorsum of the hand, up the posterolateral arm and across the acromion and suprascapular region to the lower cervical spine, with a wedge-shaped area of hypalgesia in the palm to the wrist. X-rays showed narrowing of the disc between the 6th and 7th cervical vertebrae.

Diagnosis: Compression of right 7th cervical nerve root by intervertebral disc herniation.

Case No. C7-6. Mrs. M.G., age 90, developed pain in the right upper medial scapular region extending down the lateral arm to the hand, related in onset to a right neck injury and soreness 3 years previously and increased by heavy work. The most persistent pain has been in the upper medial scapular region and lateral to the elbow. Numbness in the tips of the 1st and 2nd fingers has been noted, with tingling sensation extending to the 3rd finger and thumb and also in lesser degree up the lateral arm and over her shoulder.

Examination by light pin scratch showed a definite strip of faintly reduced pain sensation extending from the first 2 fingers up the lateral arm, and over the acromion and suprascapular region to the lower cervical spine, with a wedge-shaped area of hypalgesia in the palm. Paresthesia or tingling sensation also was plotted by passing the pin point from the normal to the involved zone, and was found to extend 1–2 cm. beyond and parallel to the hypalgesia zone, the full length of the dermatome. This was interpreted as representing the overlap innervation of this nerve root.

Diagnosis: Compression of right 7th cervical nerve root by intervertebral disc herniation.

Case No. C7-7. Mr. H.B., age 40, developed sharp pain which began in his left middle finger following an injury and extended up the posterolateral surface of the arm with dull ache in the shoulder and a drawing sensation in the neck. Before this he had noted some electrical shock sensation in this finger while working. Numb sensation developed in the middle finger, extended to ring finger, index finger and thumb, later under neck traction disappeared from thumb and ring finger, tending to return in thumb when traction off. The pain was more severe when he was lying down, often necessitating that he sleep sitting up.

Examination by light pin scratch showed a definite strip of faintly reduced pain sensation extending from the index and middle fingers up the lateral arm and over the acromion and suprascapular region to the lower cervical spine, with a wedge-shaped area of hypalgesia on the palm.

Diagnosis: Compression of left 7th cervical nerve root by herniation of an intervertebral disc.

Case No. C7-8. Mr. J.B., age 36, first developed right posterior neck stiffness 1 year previously which extended into right suprascapular region when riding a tractor. This shoulder pain increased, with some extension down the lateral arm and numbness and loss of power in the right hand. The chief numbness was in the middle finger, although some in the 1st finger and thumb, extending down laterally from the elbow. This bothered him when screwing bolts on machinery and lying in a barber chair "about drove him crazy" with pain in his shoulder blade. Looking to the right caused shooting pain down his shoulder and arm.

Examination by light pin scratch showed a definite strip of faintly reduced sensation extending from his first 2 fingers up the lateral arm and over the acromion and suprascapular region to the lower cervical spine, with a wedge-shaped area of hypalgesia on the palm and some paresthesia sensation in the same areas.

Diagnosis: Compression of right 7th cervical nerve root by herniation of intervertebral disc.
DERMATOME HYPALGESIA WITH CERVICAL DISC

Operation: A definite small firm disc herniation was found beneath the right 7th cervical nerve root, not very satisfactorily removed.

Progress: Some relief of right shoulder pain but tending to recur with bothersome numbness in hand, mostly in 1st and 2nd fingers, with remaining 7th cervical nerve root dermatome hypalgesia.

Case No. C7-9. Mr. T.T.A., age 46, first developed a stiff neck and right upper shoulder soreness with pain which descended laterally to the elbow. This disappeared but recurred 6 months later, this time extending into the 1st and 2nd fingers with numb, "asleep" prickly sensation, made worse by bending the neck. Some cutting pain was noted in the right pectoral region. Pain on the dorsal side of the hand and lateral forearm was quite severe and disabling.

Examination by light pin scratch showed a definite strip of faintly reduced pain sensation extending from the first 2 fingers up the lateral arm to the acromion, not traced further, with a wedge-shaped area of hypalgesia in the palm from the first 2 fingers.

Diagnosis: Compression of right 7th cervical nerve root by herniation of intervertebral disc.

Case No. C7-10. Mrs. F. M., age 40, developed pain in her left shoulder and arm 2 years previously, centering at the upper medial border of the scapula and radiating down the posterolateral arm to the fingers, not localized to any certain fingers. Coughing has increased this pain and it has been much more severe recently, somewhat relieved by traction but recurring when off. There has been some complaint of lateral pectoral pain. Nine years ago she received a rather severe neck injury requiring a cast for 3 months but with this she had no arm pain.

Examination by light pin scratch outlined a dermatome strip of faintly reduced sensation which extended from the first 2 fingers up the posterolateral arm and over the acromion and suprascapular region to the lower cervical spine. There was tenderness to pressure over the left 6th and 7th cervical transverse processes. X-rays showed a slightly narrowed disc between the 6th and 7th cervical vertebrae with reversal of normal curve of the cervical spine at this level.

Diagnosis: Compression of left 7th cervical nerve root by herniation of intervertebral disc.

Operation: Removal of definite disc herniation tumor beneath the left 7th cervical nerve root.

Progress: Satisfactory recovery from completely disabling left arm pain.

Case No. C7-11. Mr. R.G.R., age 44, developed stiffness in lower neck posteriorly, 3 months ago. The next day pain extended down over scapula into lateral shoulder and arm to index and middle fingers. A particularly sore spot was located at the upper medial angle of the scapula and he couldn't straighten his neck up. The first 2 fingers felt like they were "asleep" or frozen. There has been some improvement, except worse again a few days ago. He still tends to carry his head forward and has some numbness in the first 2 fingers, not the thumb, possibly slightly in the 3rd finger. Motor weakness has been noted in lifting at the elbow, also some soreness in the lateral pectoral region, thought possibly heart trouble. Seven months before the development of this trouble he fell down some stairs, hit the back of his head and injured his neck, conscious of some remaining soreness.

Examination by light pin scratch showed a faint but definite strip of reduced sensation extending from his first 2 fingers up the lateral arm and over the acromion and suprascapular region to the lower cervical spine. Pressure over the left lower cervical transverse processes sends pain into this arm in the exact distribution of the hypalgesia and he tends to hold his head forward because of pain. X-rays of his cervical spine showed anterior border hyperostosis between 3rd and 4th vertebrae, narrowing of disc between 5th and 6th vertebrae, no significant pathology of disc between 6th and 7th vertebrae. The cervical spine seemed rather fixed in the lateral views with hyperflexion and extension.

Diagnosis: Compression of left 7th cervical nerve root by herniation of intervertebral disc between 6th and 7th cervical vertebrae.
Case No. C7-12. Mrs. E. B., age 84.  
Case No. C7-14. Mr. D.A.B., age 43.  
Case No. C7-15. Mr. H.C.N., age 59.  
Case No. C7-16. Mr. H.R.S., age 46.  
Case No. C7-17. Mr. H.J., age 53.  
Case No. C7-18. Mr. F.R., age 41.  
Student No. C7-1. Mr. L.H.B.

EIGHTH CERVICAL DERMATOME HYPALGESIA

Case No. C8-1. Mr. H.C., age 54, first developed pain over the left scapula which soon extended down this arm. The next day he noted numbness on the ulnar side of this hand and forearm with loss of grip and ability to open this hand well. The greatest numbness was in the little finger although the ring finger "felt sort of numb" at the tip. Movement of his head forward caused a "catch" sensation and pain in his left shoulder. He had noticed some "wasting" or atrophy of the small muscles of this hand and was as much concerned about this evidence of motor paralysis as he was of the intolerable pain of 2 weeks' duration.

Examination by light pin scratch outlined a very definite strip of faintly reduced sensation extending from the little and ring fingers up the ulnar side of the hand and wrist along the posteromedial arm to the posterior shoulder and midscapular region to the junction of cervical and thoracic spine (Fig. 8). A similar but slightly larger dermatome area of paresthesia could be outlined by stroking the pin from the normal to the involved zone. Testing of temperature sensation by ice tube likewise identified the dermatome area. Fibrillations and weakness were noted in the triceps muscle and definite atrophy in the small muscles of the hand, with inability to open or close this hand completely on the ulnar side (Fig. 9). Circumference of the left forearm and upper arm was 2 cm. less than on the right. Pressure over the scalenus anticus muscle and brachial plexus caused no unusual pain, but pressure over the left 7th cervical transverse process caused pain in the neck and shoulder. X-rays showed marked narrowing of disc between 6th and 7th cervical vertebrae.

Fig. 8. Case C8-1. Dermatome hypalgesia of 8th cervical nerve root.
Diagnosis: Compression of left 8th cervical nerve root by herniation of disc between 7th cervical and 1st thoracic vertebrae with sensory and motor paralysis from single nerve root loss.

Operation: A very definite tense compressible herniation tumor was found beneath the left 8th cervical nerve root. This was satisfactorily removed by splitting through its capsule when free nucleus pulposus fibrocartilage extruded itself and was further removed by clamp traction.

![Fig. 9. Case C8-1. Atrophy and motor weakness of left hand from loss of 8th cervical nerve root.](image-url)

Diagnosis: Compression of left 8th cervical nerve root by herniation tumor.

Progress: There was prompt relief from left shoulder and arm pain, with gradual recovery of sensation and motor function.

*Case No. C8-2.* Mrs. R.F., age 30, developed difficulty raising her left arm one morning as she got out of bed, with pain in the lower deltoid region. A few weeks later the pain extended into the upper shoulder region and down the posteromedial arm to the inner 3 fingers. No numb sensation nor atrophy was noted in this hand. The pain continued and was made worse by work.

Examination by light pin scratch showed a definite dermatome strip of reduced pain sensation which included the little and ring fingers and could be traced along the ulnar side of the hand and forearm, over the olecranon and triceps region, across the posterior shoulder and midscapular region to the cervicothoracic spine junction.

Diagnosis: Compression of left 8th cervical nerve root by herniation of an intervertebral disc.

*Case No. C8-3.* Mr. H.F., age 49, was struck on the back of his neck by an iron pipe and immediately noted that both hands felt like fire, at first seeming to involve the entire hands
but later only the little and ring fingers. The burning disappeared after a hypodermic injection but then he noted a tingling sensation in his hands and that he could not close them well, particularly on the ulnar side. This tingling or numb sensation in his little and ring fingers persisted, with considerable motor disability in the use of his hands and straightening his elbows.

Examination by light pin scratch outlined a fairly definite dermatome strip of reduced sensation which extended from the little and ring fingers up the ulnar side of hand, wrist and forearm, over the olecranon, up the posteromedial arm and over the posterior shoulder to the cervicothoracic spine junction. There was considerable atrophy of the small muscles of both hands and inability to close the ulnar side of the hands or open them completely.

Diagnosis: Compression of both 8th cervical nerve roots by herniation or protrusion of the intervertebral disc between 7th cervical and 1st thoracic vertebrae.

Case No. C8-4. Mr. A. W. W., age 70, developed neck pain several months ago when he was placed in a body cast for lower back injury, during which considerable strain was placed on his neck. This pain radiated from the lower cervical spine over both shoulders down the posterior arm to the little and ring fingers, with numb sensation in this distribution and considerable motor weakness.

Examination by light pin scratch outlined a definite dermatome strip of reduced pain sensation in both arms which extended from the little and ring fingers up the ulnar side of the hand, posterior arm and shoulder to the cervicothoracic spine junction. There was fibrillation of the trapezius muscles and considerable atrophy of the small muscles of both hands, with tenderness to pressure over the 7th cervical spine.

Diagnosis: Bilateral compression of 8th cervical nerve root over a degenerated and protruding disc between the 7th cervical and 1st thoracic vertebrae.

Operation: Bilateral decompression of both 8th cervical nerve roots over a soft protruding disc, with prompt relief.

Case No. C8-5. Dr. H.F.J., age 49, first developed recurrent aching in left shoulder with some muscle atrophy, called subdeltoid bursitis. Three or 4 years later he noted pain at the base of his neck posteriorly extending over the spines of both scapulae with a peculiar hypersensitive reaction in skin. Both arms began to fatigue easily, the glove on his left hand felt tight and a peculiar tingling sensation was noted in the left little and ring fingers. The right hand was similarly involved a few months later and this has persisted, more on the left. He noted that flexion of his neck caused tingling in his little and ring fingers, with some burning sensation up the medial arm and scapular spine region, with definite shooting, electric feelings down the inner aspect of his arms into the ulnar side of both hands and little and ring fingers. Some aching was present in his back just medial to the upper scapula. Atrophy of the small muscles of his hands was noted, more on the left.

Examination by light pin scratch outlined a bilateral strip of reduced pain sensation extending from the little and ring fingers up the ulnar side of the hand and forearm, postomedial arm, and over the posterior shoulder and scapular spine to the cervicothoracic spine junction, more definite on the left. There was evident atrophy of the small muscles of the left hand and of the left trapezius and posterior scapular muscles. Pressure on the top of the head and turning to the left caused characteristic tingling sensation extending into ulnar side of left arm and hand.

Diagnosis: Bilateral compression of 8th cervical nerve roots over a degenerated protruding disc between 7th cervical and 1st thoracic vertebrae.

Case No. C8-6. Mr. L.W., age 38, injured his neck in an auto collision and a few months later developed a “clicking” or “cracking” sensation in his lower neck on forward or backward bending, with some pain extending over both shoulders and down the postomedial arms, and some numb sensation in the little and ring fingers and ulnar side of hands. The pain was steady and increased by sneezing or exertion.

Examination by light pin scratch outlined a definite strip of reduced pain sensation in both arms extending from the little and ring fingers up the ulnar forearm, postomedial arm and
over the posterior shoulder and scapular spine to the cervicothoracic spine junction. There was marked tenderness over the 7th cervical and 1st thoracic spines and an audible "crack" was noted in the lower neck on flexion and extension.

Diagnosis: Bilateral compression of 8th cervical nerve roots over a degenerated protruding disc between 7th cervical and 1st thoracic vertebrae.

Operation: Bilateral decompression of 8th cervical nerve roots over disc protrusion.

Progress: Satisfactory relief from arm pain but requiring some neck protection.

Case No. C8-7. Mr. L.T., age 52, developed a "spot" of pain in the left shoulder, located near the medial upper angle of the scapula, with numbness in the left arm, as though he had slept on it. For several years he has had occasional "slipping" sensation in his lower neck posteriorly.

Examination by light pin scratch outlined a rather faint strip of reduced pain sensation extending from the left ulnar forearm up the posteromedial arm, over the posterior shoulder to the cervicothoracic spine junction.

Diagnosis: Compression of left 8th cervical nerve root by variable protrusion of a degenerated unstable disc between the 7th cervical and 1st thoracic vertebrae.

Case No. C8-8. Miss D.L., age 18, developed aching pain in her left shoulder, near the upper medial angle of the scapula, on the day following an automobile accident. With this there was tingling, numb sensation in the ulnar side of the left hand, particularly in the little finger. This continued and was treated by neck traction without much relief. Bending the neck backward increased the pain and tingling.

Examination by light pin scratch outlined a definite strip of reduced pain sensation extending from the left little and ring fingers up the ulnar side of hand and forearm, posteromedial arm and posterior shoulder to the cervicothoracic spine junction. She held her head forward and resisted backward bending because of pain. Jugular compression caused a tingling sensation down the posteromedial arm to the little finger. Slight small muscle atrophy of the left hand was noted.

Diagnosis: Compression of left 8th cervical nerve root by herniation of disc between 7th cervical and 1st thoracic vertebrae.

Case No. C8-10. Mrs. C.G., age 52.
Case No. C8-12. Dr. H.A.F., age 58.
Student No. C8-1. Mr. E.D.
Student No. C8-2. Mr. T.H.
Student No. C8-3. Mr. H.R.

FIRST THORACIC AND EIGHTH CERVICAL

Anterior Primary Division Dermatome Hypalgiesia

Case No. T1-1. Mr. P.T., age 21, developed pain and numbness in right arm 18 months previously, increasing in severity. The pain began in the right little finger and spread along the inner arm to the lateral shoulder, and was increased by "throwing his shoulders back."
The numbness included his right little and ring fingers and extended indefinitely up the ulnar side of his hand and forearm. He had noted motor weakness in this hand and arm and wasting of the small muscles of his hand. Milder similar symptoms were noted in the left arm and hand.

Examination showed definite atrophy of the small muscles of the right hand and decreased ability to close and open the little and ring fingers. Testing by light pin scratch outlined a definite strip of reduced sensation which extended from the right little and ring fingers up the medial arm to the axilla where it stopped posteriorly at the outer border of the scapula.
and extended anteriorly below the clavicle to the sternum (Fig. 10). A similar but fainter area of hypalgesia was found on the left arm. X-rays showed bilateral short cervical ribs.

Diagnosis: Compression of lower primary cord of the brachial plexus by cervical rib, with hypalgesia representing distribution of anterior primary division of 8th cervical and 1st thoracic nerve roots.

Fig. 10. Case T1-1. Hypalgesia of anterior primary divisions of 1st thoracic and 8th cervical nerve roots found with scalenus anticus muscle compression of lower primary trunk of the brachial plexus.

Case No. T1-2. Mr. R.L., age 59, developed soreness, numbness and weakness of his right arm after an operation for strangulated hernia. The entire arm felt dead on the table but there was some decrease in numbness after operation, being more noticeable along ulnar side of hand, little and ring fingers. Use of this hand was considerably impaired by weakness of finger motions with some wasting of small muscles of hand noted.

Examination by light pin scratch showed a fairly definite strip of reduced pain sensation which extended from the little and ring fingers up the inner arm to the axilla where it divided into two extensions, one anteriorly to the sternum over the 1st intercostal area, and the other posteriorly to the lateral border of the scapula. Definite atrophy of the small muscles of the hand was present.

Diagnosis: Compression or stretching of the lower primary cord of the brachial plexus, representing anterior primary divisions of 8th cervical and 1st thoracic nerve roots.

Case No. T1-3. Mrs. S.K., age 36, first noted pain in front of left shoulder when holding a book forward in this hand for considerable time in choir practice. There was no pain on the back of the shoulder. This pain extended downwards along the inner side of this arm with numbness in her fingers, not well localized. Active use of the arm tended to relieve the symptoms, also using an extra pillow at night to bring her head and shoulders forward.

Examination by light pin scratch outlined a strip of reduced pain sensation which extended from the little and ring fingers over the ulnar side of the hand and as a wider band along the ulnar side of the forearm and inner arm to the axilla where it divided into two extensions, one passing forward to the sternum over the 1st intercostal space and the other posteriorly over the shoulder to the lateral scapular region, not traceable over the scapula to the spine as with 8th cervical nerve root compression. X-rays showed no cervical rib.

Diagnosis: Compression of lower primary cord of the brachial plexus by the scalenus anticus muscle. The area of hypalgesia plotted represents the combined distribution of the
Dermatome Hypalgesia with Cervical Disc

Anterior primary divisions or rami of the 8th cervical and 1st thoracic nerve roots, of which the lower primary cord is composed, and does not include the posterior primary division distribution over the scapula.

Case No. T1-4. Miss A. C., age 22.
Case No. T1-5. Mrs. V. E., age 35. (See Case No. C6-3.)
Case No. T1-6. Dr. A. J. F., age 32.
Case No. T1-8. Mrs. J. L., age 32.
Student No. T1-1. Mr. W. M.
Student No. T1-2. Mr. R. G.

References