Cervical conjoined nerve root variant: preoperative imaging and surgical confirmation

Case report

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A case of a nerve root anomaly in a patient presenting with cervical radiculopathy is presented. The patient was treated with posterolateral exploration and decompression, resulting in relief of pain and improvement in strength. Both the preoperative contrast-enhanced computerized tomography scan and the magnetic resonance image demonstrated an abnormality behind the C-4 body extending from the right C3-4 neural foramen to the neural foramen at C4-5. At surgery, a dural-encased structure was discovered connecting the C-4 and C-5 nerve roots within the spinal canal. This paper describes the first reported case of a cervical nerve root anomaly of this type, representing a variant of a conjoined nerve root. The occurrence of such nerve root anomalies in the cervical spine should be entered into the differential diagnosis and treatment of cervical radiculopathy.

Key words • nerve root anomaly • cervical spine • radiculopathy • surgical decompression

Although conjoined nerve roots are recognized anomalies of lumbosacral nerve roots, to our knowledge they have not been previously described in the cervical spine.1-4 We report the case of a patient who presented with C-5 and C-6 radiculopathies and was found to have a right-sided nerve root anomaly involving the C-4 and C-5 nerve roots. This anomaly appeared to be a conjoined nerve root variant.

Case Report

This 65-year-old man presented with a 9-month history of progressive weakness in his right arm associated with neck pain radiating from his right shoulder into the lateral upper arm. He had no complaints with respect to his left upper extremity or either of his lower extremities.

Examination. Physical examination revealed wasting of the right deltoid, supraspinous, and biceps muscles with fasciculations. The patient was unable to fully abduct the right arm against gravity, and right elbow flexion and wrist supination were diminished. The right biceps deep-tendon reflex was decreased compared to the left. There were no sensory deficits. The left upper extremity was normal, and there were no long-tract signs. Electromyographic studies revealed fibrillation in the right deltoid and biceps muscles with decreased recruitment and polyphasic motor unit potentials consistent with C-5 and C-6 radiculopathies.

Myelography revealed stenosis at the C-3 level due to posterior ligamentous impingement and effacement of the anterior column of contrast material at the C3-4 interspace which was not explained on the basis of osteophytes or disc protrusion (Fig. 1). Anteroposterior images suggested right-sided nerve root impingement at C4-5 and C5-6. Contrast-enhanced computerized tomography (CT) scans revealed narrowing of the right C4-5 and C5-6 neural foramina due to osteophytes spurring as well as the anomalies demonstrated in Fig. 2. At the C3-4 level, a separate, low-attenuation mass surrounded by contrast enhancement was demonstrated in the right ventrolateral aspect of the canal without significant mass effect (Fig. 2 left). Cuts at the level of the C-4 vertebral body (Fig. 2 center) and at the C4-5 interspace (Fig. 2 right) demonstrated that this defect continued in the same position with the surrounding contrast enhancement dissipating along its
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Operation. Our surgical goal was to decompress the C-5 and C-6 nerve roots and to explore the lesion. A unilateral dorsal exposure was performed from C-3 through C-6 and standard “keyhole” foramotomies were performed at C-4–5 and C-5–6 to relieve the neural foraminar narrowing shown in the imaging studies. A limited medial foramotomy was performed at C-3–4 to expose the origin of the C-4 nerve root, and the right lamina was removed from C-4 so that the lateral aspect of the dura was visible from the shoulder of the C-4 nerve root through the C-5 nerve root. The medial aspect of the lateral mass of C-4 was then removed with a burr down to a point in line with the medial side of the C-4 pedicle, and the medial 2 to 3 mm of the pedicle was also removed. The lateral part of the right C-3–4 and C-4–5 joints was left intact.

Retraction of a vein running rostrocaudally along the juncture of the middle and lower thirds of the dura disclosed what appeared to be a fold. Careful probing of this fold opened it up and revealed a dura-encased structure that arose in the axilla of the C-4 nerve root and traveled separately along the dura to the C-5 nerve root where it re-entered the dura (Fig. 4). This was consistent with our preoperative suspicion of a cervical conjoined nerve root.

Postoperative Course. At 6 months after the operation, the patient had no pain in the neck or upper extremity and no subjective limitation of function. Objectively, there has been a notable increase in strength in the previously weak right upper extremity muscles, with 5/5 strength in shoulder abduction and 5/5 strength in wrist supination and elbow flexion. The wasting of the right deltoid, supraspinous, and biceps muscles has almost completely resolved, and fasciculations are no longer present in these muscles.

Discussion

Anomalies in the origin and course of lumbosacral nerve roots are well documented in the literature, with conjoined nerve roots being found most frequently.$^{3,4}$
The conjoined nerve root anomaly, wherein two nerve roots share a common dural sleeve but generally exit via their appropriate, separate neural foramina, is to our knowledge previously unreported in the cervical spine. However, a case in which two cervical nerve roots were joined lateral to the pedicle has been reported.5

The present situation has been termed a “conjoined nerve root variant” because, although the common dural exit and preforaminal course of the roots arising at the C-4 level correspond to the definition of a conjoined nerve root, the existence of a separate additional C-5 nerve root that subsequently fuses with the lower component of the bifid C-4 nerve root appears to represent the additional anomaly of a C-5 nerve root with elements from both C-5 and C-4. Whether conjoined nerve roots occur in an uncomplicated fashion in the cervical region is unknown.

Lumbosacral conjoined nerve roots are generally asymptomatic. In symptomatic cases, the patient’s complaints are generally attributable to nerve root compression due to disc protrusion or osteophytic disease.2,3 This is similar to the case presented here, in which the patient’s complaints appear to have been related to compression of the C-5 and C-6 nerve roots by osteophytes, although it is possible that the increased size of the C-5 nerve root due to the inclusion of C-4 fibers might have made it more susceptible to compression in the lateral recess or neural foramen.

Due to the absence of previous reports, the possibility of a conjoined nerve root or a variant thereof was not included in the initial interpretation of the extraaxial anomaly at the C-4 level. The initial reading suggested probable herniated disc with cranial extension, a radiological error in keeping with the most frequent misinterpretation associated with conjoined lumbar nerve roots.4 Such a misinterpretation, in the cervical spine, might precipitate an anterior approach requiring more extensive dissection as well as fusion. Since exploration and decompression of the communicating sleeve are probably less important to a good outcome than decompression of the root in the neural foramen, preoperative recognition of such an anomaly in the cervical spine could have significant influence on the surgical procedure performed.

The true frequency of nerve root anomalies in the cervical spine cannot be estimated. The paucity of previous reports is most likely attributable to the greater difficulty in diagnosing this condition in the cervical spine as compared to the lumbosacral region using current radiographic techniques. High-resolution postmyelographic CT imaging has greatly facilitated the diagnosis of conjoined nerve roots in the lumbosacral region. Magnetic resonance imaging techniques such as fast imaging with steady-state precision and gradient recall acquisition in the steady state, which improve imaging sensitivity in the lumbar spine by providing high cerebrospinal fluid (CSF) contrast enhancement, do not achieve the same effects in the cervical spine due to greater flow dynamics in the cervical CSF.5 As a result of this report documenting the radiographic ap-

Fig. 3. Left and Center: Fat-suppression axial magnetic resonance (MR) imaging studies at C-4 (left) and C4–5 (center) demonstrating a right ventrolateral area of low signal (arrow) surrounded by cerebrospinal fluid density. Right: T1-weighted right parasagittal MR image demonstrating a structure (arrows) appearing to arise from the cord at the C3–4 level and extending inferiorly to the level of the C4–5 disc.

Fig. 4. Intraoperative photograph showing a dura-encased structure (arrow) arising in the axilla of the C-4 nerve root (4) and traveling separately along the dura to the C-5 nerve root (5), where it re-enters the dura. The lateral edge of the dura is indicated by the arrowhead, and an epidural vein is being retracted with a No. 4 Penfield retractor. P = C-4 pedicle.
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pearance of a surgically confirmed cervical conjoined nerve root variant, further developments of more sophisticated imaging modalities should facilitate diagnosis of this apparently infrequent entity and allow a proper estimate of its occurrence.

References


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