Late results of cervical disc surgery

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Late results of cervical disc surgery have been reported and statistically studied in 383 cases; 83% were lateral discs, 13% were central spondylosis discs, and 4% central soft discs. Central spondylosis occurred at a higher spinal level, and caused cord compression with or without weakness of the hands, but no pain. A posterior approach was used in all lateral discs, and either an anterior or a posterior approach, with or without fusion, for central discs. Preoperative myelography was always done and is recommended postoperatively in central disc surgery to evaluate the results. Our results were good to excellent in 95% of lateral discs, in 64% of central spondylosis discs, and in an unexpected 91% of 11 cases of central soft discs. There were no recurrences and no serious complications, although 20% developed other cervical or lumbar disc herniations.

KEY WORDS • cervical disc • spondylosis • posterior approach

ONE of us (WBS) has been interested in cervical disc surgery since the development of a lateral extradural posterior approach\textsuperscript{15,19} for lateral discs and decompressive facetectomy and laminectomy for central spondylosis\textsuperscript{18}. Of the 1600 cervical disc operations performed in the Department of Neurosurgery at the Hartford Hospital, the majority have involved lateral discs, performed via a posterior approach. This paper reviews the late results of surgery for cervical disc disease, both lateral and central, based on the 383 cases operated on by WBS since 1941.

Study Procedure

Follow-up has been obtained on 296 patients, and in 208 cases it ranged from 5 to 33 years. Results were derived from responses to questionnaires by 246 patients, supplemented by office visits. All patients were asked to estimate their recovery as excellent, good, fair, poor, no improvement, or worse. "Good to excellent" indicated significant improvement. Patients were asked to describe residual difficulties in walking, weakness, numbness or pain in the neck, arms, or hands, and other complications. Thirty patients were followed from 20 to 33 years, 76 patients from 10 to 20 years, and 65 patients from 5 to 9 years. An additional 75 patients with a 1- to 4-year follow-up have been included in the classification category only.

Cervical disc pathology falls into five distinct categories\textsuperscript{18} that differ widely in their incidence, symptomatology, and operative approaches. They include lateral disc protrusions, of which the majority are soft, rather than the hard osteophyte variety. These constitute 83% of our operations. Another 13% of the series consisted of the central bar ridge spondylosis type, and 4%
were the rare central soft disc variety. Fracture-dislocations accompanied by disc protrusion are not included.

**Lateral Disc Lesions**

**Diagnosis**

Lateral disc herniation causes neck pain with nerve-root radiation to the medial scapula and down one arm into the hand and certain fingers, with isolated motor and reflex deficits. Pain down the arm sufficient to prevent sleep or work, rather than motor weakness, is our chief criterion for surgery. The most important test is duplication of nerve pain by the neck-compression test, usually relieved by upward traction. Specific nerve-root weakness can be demonstrated with deltoid and brachioradialis weakness occurring in disc lesions at the C4-5 interspace,\(^8\) biceps weakness and numbness or tingling in the thumb and index fingers at the C5-6 interspace, triceps weakness and numbness in the index and middle fingers at the C6-7 interspace, and weakness of the flexor carpi ulnaris and sometimes extensors digitorum with subjective numbness in the fourth and fifth fingers at the C7-T1 interspace. Lateral hard discs or osteophytes less commonly cause painful nerve-root syndromes and their myelographic defects are generally bilateral rather than unilateral. Diabetes and wrist-entrapment syndromes may cause painless deficits in contradistinction to the arm pain of lateral disc protrusions.

**Laboratory Studies**

In our series, routine cervical spine films were of little help because approximately 50% were normal, and 20% showed arthritic narrowing and ankylosis at a space adjacent to but not at the site of a ruptured disc. The spinal fluid protein was moderately elevated in approximately 50% of these patients. Myelography was positive in almost all of our cases but frequently showed only a unilateral minimal root sleeve defect. Bilateral arthritic root sleeve defects are infrequently symptomatic. Our cervical myelograms are done on an outpatient basis with a No. 20 needle, and involve removal of all dye; The patient may walk immediately, after taking four glasses of water by mouth. Headaches have occurred in one out of 20 cases. Discograms are not used because they may be positive in asymptomatic necks.\(^8\)

**Operative Technique**

Our operative techniques for lateral cervical disc disease have been described more fully elsewhere.\(^5,14,18\) Lateral disc surgery is usually done under a local cervical block with the patient in a sitting position. A Doppler machine is used and venous pressure is raised by abdominal binders. We may use positive pressure general anesthesia, and sometimes atrial venous catheterization and tidal CO\(_2\) monitoring\(^1\) — all as a precaution against air embolism. Partial facetectomy is accomplished by using first a D’Errico hand drill, followed by an air drill with a diamond-coated burr to expose the root sleeves and lateral edge of the dura. The sensory and motor nerve root sleeves are separated and retracted upward or downward by a nerve hook exposing the soft disc fragment, which is then incised and milked out from under the axilla of the root sleeve (Fig. 1). An osteophyte is removed by chisel and rasp only if it is of very large size.

**Summary of Cases**

Lateral cervical disc herniation occurred in a male to female ratio of 2.6:1.0. In 70% of
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cases, patients presented between the ages of 40 to 60 years of age, with a mean age of 52 years in males and 48 years in females; less than 20% gave a history of antecedent injury. The disc protrusions were of the soft type in 177 (72%) cases and were hard osteophytes in 69 (28%). In 1% rupture occurred at the C3-4 level, in 4% at C4-5, in 35% at C5-6, in 54% at C6-7, and in 7% at C7-T1 levels. Simultaneous multiple cervical disc lesions were found in less than 2% of patients; there have been no recurrences so far, in contradistinction to results with lumbar discs.

The late results are shown in Table 1. One third of the patients returned to work or to their former activities within 2 weeks; the average time was 4.2 weeks, 3.9 weeks for males and 5.0 weeks for females; 96% of the males and 100% of the females returned to the same job. Little correlation was noted between results and age or heavy labor. Nor was there a significant difference associated with compensation/liability factors. Continuing complaints were minor and related to paresthesiae or mild pain. Interestingly, the older age group (40 to 70 years) did somewhat better postoperatively than younger persons. Minor weakness was described in three times as many patients with disc rupture in the upper and lower extremes of location (C4-5 and C7-T1), as those with discs at the usual C6-7 and C5-6 levels (Table 2).

Nineteen percent of all lateral disc patients (21% male; 16% female) developed other cervical (8%) or lumbar (11%) disc herniations requiring operation. Surprisingly, 43% of patients with a C7-T1 disc disease developed lumbar disc herniations as compared to 5% at higher levels. Heavy laborers escaped having multiple disc lesions.

Central Cervical Spondylosis

Hard spondylosis-type disc herniation with a central bar ridge occurred only after middle age, and operable cases were generally limited to one space in the midcervical region, whereas multiple arthritic ridging occurred in the lower cervical area and was not usually operable unless accompanied by a congenital stenosis. In this series, patients were not operated on for neck pain alone, although Robertson believes that an occasional case of intractable neck pain warrants operation if diagnostic saline injection into the proper interspace duplicates the pain.

<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
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<tbody>
<tr>
<td>Quality of recovery in 171 patients after lateral disc surgery*</td>
</tr>
<tr>
<td>Result</td>
</tr>
<tr>
<td>excellent</td>
</tr>
<tr>
<td>good</td>
</tr>
<tr>
<td>fair</td>
</tr>
<tr>
<td>poor</td>
</tr>
<tr>
<td>no improvement</td>
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<tr>
<td>worse</td>
</tr>
<tr>
<td>death</td>
</tr>
</tbody>
</table>

* Follow-up from 5 to 33 years, with a mean of 21 years.

<table>
<thead>
<tr>
<th>TABLE 2</th>
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<tbody>
<tr>
<td>Levels of cervical disc surgery in 296 patients</td>
</tr>
<tr>
<td>Level</td>
</tr>
<tr>
<td>C3-4</td>
</tr>
<tr>
<td>C4-5</td>
</tr>
<tr>
<td>C5-6</td>
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<tr>
<td>C6-7</td>
</tr>
<tr>
<td>C7-T1</td>
</tr>
<tr>
<td>double</td>
</tr>
<tr>
<td>total</td>
</tr>
</tbody>
</table>

Diagnosis

We have operated on only those cases with signs of spinal cord compression manifested by progressive pyramidal tract signs in the legs, accompanied occasionally by triceps weakness with or without weakness in the hands, and showing a near total myelographic block especially in the trans-table view. This block is generally limited to one or at the most two interspaces (Fig. 2) unless stenosis is manifest. Pain is rarely present in either arms or legs. The spinal fluid protein is elevated in the majority of cases. Discography, as in lateral discs, has been discarded by nearly all neurosurgeons using posterior, and a majority using anterior operations.

Operative Technique

An anterior or posterior approach may be used in spondylosis cases. The two anterior approaches with fusion have been adequately described by Cloward and Robinson with
or without removal of the bar ridge and lateral osteophytes. Originally Hirsch, et al., and more recently Boldrey, Robertson, Tew, and others have carried out anterior removal without fusion in selected cases. Our posterior approach consists of a bilateral partial facetectomy (foraminotomy) followed by an extensive decompressive laminectomy. The facetectomy removes the tethering effect on the root sleeves making it unnecessary to open the dura or cut the dentate ligaments, procedures now advocated by only a few surgeons. The anterior approach permits removal of ventral pressure by the bar ridge as well as stabilization when fused. The posterior approach permits removal of the infolded ligamentum flavum and a dorsal migration of the entire dural contents and root sleeves away from the bar ridge. Postoperative myelograms in 12 patients have confirmed complete or nearly complete relief of the block. Both approaches have been equally effective in removing the myelographic block.

In the posterior approach, the patient is placed in an upright position, and a cervical block or general anesthesia is given as in patients with lateral discs, with the same precautions against air embolism. After performing bilateral partial facetectomy, as done unilaterally in lateral discs, a decompressive laminectomy is carried out two laminae above and two laminae below the sites of myelographic block. Extreme gentleness is used when touching the dural contents. One or more bilateral facets have been totally removed without fear of anterior dislocation in this group of middle-aged patients. As in lateral disc lesions, the patient is encouraged to walk early. There is an anticipated hospital stay of 5 to 7 days, and patients wear a Philadelphia collar* for 1 week.

Summary of Cases

Thirty-nine cases of central spondylosis occurred with a 10:1 predominance in males at an average age of 60 years. Spondylosis occurred at the midcervical spine, whereas lateral ruptured discs and osteoarthritis usually occur at lower cervical levels (Table 2). Spinal fluid protein was elevated in 18 of 23 patients tested, with an average of 81 mg%. We performed a posterior decompressive laminectomy with partial facetectomy unilaterally in seven patients, and bilaterally in 31, and an anterior discectomy with fusion in one. Ruptured discs occurred at other levels in 23% of these patients, at the cervical level in one, and lumbar in seven.

Follow-up

Follow-up was obtained in 36 cases ranging from 1 to 18 years, with a mean of 8 years. The results were definitely not as good as in lateral disc patients but better than anticipated: 64% showed good-to-excellent results with clinical cure exhibited in three cases. All cases showed an objective arrest of the disease, although one patient claimed subjectively that she had been made worse. Minor adverse residuae from operation occurred in five cases: weakness and numbness were slower to improve in the hand than in the leg, but ultimately more complete. There were no infections and no deaths. In one case, the wrong level was operated on and the patient required reoperation; and in one wound dehiscence was seen. There were three incorrect diagnoses in patients who had decompressive laminectomies without clinical improvement; later studies indicated multiple sclerosis, congenital anomaly of the odontoid, and ascending anterior spinal artery infarction.

Central and Paracentral Soft Cervical Discs Diagnosis

We have operated upon 11 cases with large, centrally located, soft discs; seven with partial spinal cord paralysis and four with unilateral root paralysis from paracentral, free-fragment disc protrusions (Table 3). Preoperative myelogram showed a complete block in all patients, operation revealed central or paracentral ruptures, and all but one yielded good results.

Operative Procedure

The ideal approach should be via an anterior discectomy, but often one cannot be certain of the diagnosis preoperatively; hence, diagnostic operations are frequently done from a posterior approach. In our 11 cases, four different approaches were used: 1)
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### TABLE 3

**Eleven cases of soft cervical disc lesions**

<table>
<thead>
<tr>
<th>Sex, Age (yrs)</th>
<th>Location</th>
<th>Symptoms</th>
<th>Myelogram</th>
<th>CSF Protein mg/%</th>
<th>Operation</th>
<th>Follow-up</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>central soft cervical disc</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M 55</td>
<td>C6-7</td>
<td>3 mos progressive weakness and numbness hands; paraparesis</td>
<td>transverse block C6-7</td>
<td>104</td>
<td>1947: laminectomy-facetectomy; combined intra- and extradural removal</td>
<td>5 mos; (moved away)</td>
<td>good—rapid recovery, hand and leg pareses 1 mo</td>
</tr>
<tr>
<td>M 44</td>
<td>C3-4</td>
<td>sudden quadriparesis with Babinski; sensory level 4th dorsal</td>
<td>block C3-4</td>
<td>60</td>
<td>1956: hemilaminectomy with extradural partial removal</td>
<td>17 yrs</td>
<td>no change; walks with canes</td>
</tr>
<tr>
<td>F 29</td>
<td>C5-6</td>
<td>sudden spastic paraparesis; Brown-Sequard; ulnar numbness</td>
<td>block C3-4</td>
<td>78</td>
<td>1962: laminectomy-facetectomy; combined unilateral intra- and extradural removal</td>
<td>10 yrs</td>
<td>excellent</td>
</tr>
<tr>
<td>M 53</td>
<td>C3-4</td>
<td>paraparesis; Brown-Sequard sensory level T-4; hand weakness</td>
<td>block C3-4 partial block C4-5</td>
<td>none</td>
<td>1965: laminectomy, 10 yrs bilateral extradural removal</td>
<td></td>
<td>good—full activity</td>
</tr>
<tr>
<td>M 25</td>
<td>C5-6</td>
<td>3 wks spastic gait and unilateral arm pain</td>
<td>complete block C5-6</td>
<td>85</td>
<td>1972: anterior discectomy without fusion</td>
<td>1½ yrs</td>
<td>excellent</td>
</tr>
<tr>
<td>M 53</td>
<td>C4-5</td>
<td>insidious onset spastic ataxic gait; causalgia of hands</td>
<td>block C4-5 and C5-6; no block after 1st op</td>
<td>133</td>
<td>1) 1974: laminectomy-facetectomy with bilateral extradural limited removal soft disc C4-5 2) 1974: anterior discectomies and multiple fusions C4-5; C5-6; C6-7 (by Aronson and Filtzer)</td>
<td></td>
<td>unchanged after 1st op, good after 2nd op; working at 6 mos</td>
</tr>
<tr>
<td>F 36</td>
<td>C5-6</td>
<td>1 yr ataxic gait; anesthesia of hands</td>
<td>block C5-6</td>
<td>34</td>
<td>1974: anterior discectomy without fusion; hidden free fragment removed</td>
<td>1 yr</td>
<td>good—full activity</td>
</tr>
<tr>
<td></td>
<td><strong>paracentral soft cervical disc</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M 48</td>
<td>C4-5</td>
<td>2 yrs arm pain; atrophy, fibrillations deltoid, triceps, brachioradialis</td>
<td>total block C4-5 &amp; C5-6</td>
<td>39</td>
<td>1965: unilateral hemilaminectomy and triple facetectomies; removal paracentral soft disc C5-6</td>
<td>10 yrs</td>
<td>excellent</td>
</tr>
<tr>
<td>M 49</td>
<td>C6-7</td>
<td>2 yrs attacks right shoulder/arm pain; triceps weakness</td>
<td>—</td>
<td>none</td>
<td>1968: unilateral facetectomy and removal of paracentral soft disc</td>
<td></td>
<td>early results excellent</td>
</tr>
<tr>
<td>F 51</td>
<td>C5-6</td>
<td>2 yrs left arm/ index finger pain</td>
<td>total block C5-6</td>
<td>47</td>
<td>1974: hemilaminectomy with facetectomy paracentral soft disc removed</td>
<td>1 yr;</td>
<td>excellent transitory paralysis rt leg on operating table early result — immediate pain relief</td>
</tr>
<tr>
<td>M 54</td>
<td>C5-6</td>
<td>left neck and arm pain</td>
<td>total block C5-6</td>
<td>46</td>
<td>1976: anterior discectomy without fusion</td>
<td>1 mo</td>
<td></td>
</tr>
</tbody>
</table>

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limited laminectomy with unilateral facetectomy and combined intra- and extradural removal of a soft central disc by milking it laterally through an intact ventral dura\(^{12}\) (Fig. 3; this is preferred for posterior approaches); 2) laminectomy and bilateral facetectomy with bilateral extradural curettage of the disc space upon finding a central disc; 3) anterior discectomy with fusion; and 4) anterior discectomy without fusion.

In anterior approaches the preferred procedure was total removal of the disc contents with a disc spreader, including the cartilaginous bar ridge, and often the annulus and bilateral osteophytes by means of the smallest punch rongeur and minute up-biting curettes and occasionally a cylindrical air drill. Fusion by bone grafts is often unnecessary as later spontaneous fusion will occur if all disc material is removed.\(^{10,20}\) Postoperative collapse of the interspace does not in itself appear to cause kyphos or adverse symptoms.

Fracture-dislocations with central disc protrusion have not been included because their primary injury is skeletal. In such cases an anterior approach with vertebral bone\(^{21}\) or acrylic replacement\(^{17}\) may well be the approach of choice but unfortunately no operation avails unless the paraparesis is incomplete and progressing.

The results were far better than anticipated and in fact better than in the chronic bar ridge spondylosis patients, being good to excellent in all but one case (Table 3). This is possibly because only two cases were of sudden onset and none were accompanied by a total paraplegia, when irreversible changes in the anterior spinal artery circulation may occur. Complications were few; in one case with a posterior unilateral approach done with the patient under local block in a sitting position, there was a transitory intraoperative paralysis of the right leg. Another patient had a delayed transitory quadriplegia with unilateral Babinski developing on the 5th postoperative day when getting out of bed. This cleared completely in less than 1 hour.

Summary of Cases

Patients with central and paracentral cervical discs fit into the same incidence category as those having lateral soft ruptured discs. They had an average age of 45 years (25 to 55 years), a male to female ratio of 2.7:1, and an
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average spinal fluid protein of 69 mg%. A pure central soft disc presented a similar but more severe clinical picture than the bar ridge disc, while the paracentral tears caused unilateral severe root paralysis plus a myelographic block.

Discussion

Upon reviewing the late results of this series of lateral disc protrusions and comparing them with those of other surgeons using other approaches it should be stressed that our criteria and our results are almost identical to those of Murphey, et al. Neither of us operates on cases with neck pain only; we find that the majority of operable cervical discs are laterally placed soft discs rather than central spondylosis or lateral osteophyte discs, and we have found that a lateral posterior approach to this category has given us the most gratifying results of any neurosurgical operation. Over 95% noted good-to-excellent results and 97% returned to their former occupations within approximately 1 month of the operation. Of particular interest is the absence of recurrence of lateral disc protrusions in spite of nonremoval of intervertebral disc contents. Simple decompression of the nerve root sleeve overlying a lateral osteophyte has given good results. Routine cervical spine films are of little help in localization and discograms have not been used. The majority of our operations have been done with the patient in an upright position where air embolism is an ever constant danger exactly as in posterior fossa and other cervical-dorsal operations done in this position.

Of particular interest is our finding that 20% of both lateral and spondylosis disc protrusions have had ruptured discs in other locations or will develop them. This, with the rarity of trauma, makes us conclude that ruptured cervical discs are due to degenerative wear and tear rather than to specific trauma. Both central spondylosis and central soft disc protrusions gave better long-term results than we had anticipated. Regardless of whether an anterior or posterior operation was used, late myelograms showed a myelographic clearing of the block. This has been confirmed by Bakay and Fager. The relative absence of pain in arms or legs in central disc protrusions is of interest. In the rare cases of multiple arthritic ridging with cervical stenosis we recommend posterior decompressive laminectomy rather than multiple anterior fusions.

We mention briefly two unusual cases which required both posterior decompressive laminectomy and an anterior discectomy with fusion in order to obtain excellent results. Both had spastic parapareses and hand weakness, one from arthritic subluxation and the other from multiple spondyloses and a bilateral soft disc protrusion.

Addendum

Since acceptance of this paper, WBS has had his first catastrophic air embolism in 37 operative years which allegedly and inexplicably was not accompanied by a fall in blood pressure.

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W. B. Scoville, G. J. Dohrmann and G. Corkill


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