Incidence of spinal column deformity after multilevel laminectomy in children and adults

SHOZO YASUOKA, M.D., HAMLET A. PETERSON, M.D., AND COLLIN S. MACCARTY, M.D.

Departments of Neurologic Surgery and Orthopedics, Mayo Clinic and Mayo Foundation, Rochester, Minnesota

Fifty-eight patients, all less than 25 years of age, underwent multilevel laminectomy for conditions that in themselves do not usually cause spinal deformity. Spinal deformity developed in 46% (12 of 26) of the patients who were less than 15 years of age, but in only 6% (two of 32) of the patients aged 15 to 24 years. Spinal deformity developed in all (100%) patients who had cervical laminectomy, in 36% of those who had thoracic laminectomy, and in none (0%) of those who had lumbar laminectomy. There was no correlation between the occurrence of deformity and sex, number of laminae removed, neurological condition after laminectomy, or length of time after surgery.

KEY WORDS • spine deformity • kyphosis • kyphoscoliosis • vertebral body wedging • laminectomy

The possibility of kyphosis or kyphoscoliosis developing after multilevel laminectomy in children is well known to pediatric orthopedists. This retrospective study was undertaken as a joint neurosurgery-orthopedic project to determine the incidence of this important complication. Data regarding pathogenesis and prophylaxis have previously been published.

History of Condition

Braun, writing in 1910 about laminectomy in general, said, "This complicated method has become popular since the fear about the instability after the laminectomy turned out to be wrong. It has been shown that four or five or even seven laminae can be removed safely" (translated from German). Teng and Rogers in the early 1960’s, and Jenkins in 1973 noted that in adult patients the stability of the cervical spinal column was not usually impaired after multilevel laminectomy for cervical spondylosis.

In 1955, Bette and Engelhardt described three patients with multilevel laminectomy (two adolescents and one adult). After the procedure, the two adolescents, aged 14 and 17 years, had swan-neck deformity, whereas the adult patient, who was 36 years old, had no spinal deformity. Haft, et al., first pointed out the risk of kyphoscoliosis and instability developing after laminectomy for intraspinal tumor in children. Spinal deformity after multilevel laminectomy has recently become more widely recognized.

The incidence of this deformity is elusive. There are no reports showing a difference in incidence of this complication between children and adults. The four studies defining the incidence in children and adults were concerned primarily with spinal cord tumors, including such conditions as neurofibromatosis, which may cause spinal deformity without laminectomy. Patients with malignant tumors and those with short survival were also included. We believe that the incidence of this complication should be analyzed in patients whose primary condition does not alter the contour of the spinal column and in patients who live several years postoperatively.

Clinical Material

The histories of patients undergoing multilevel laminectomy during the 10-year period 1965 through 1974 were reviewed. The study was begun in 1979, allowing at least 5 years of follow-up review for the most recent case. There were 1577 patients aged 25 years or older and 248 patients 24 years of age or less. Thus, over six times more adults underwent laminectomy per year than children and young persons (an average ratio of 157.7:24.8). No patients with one-level laminectomies or multilevel hemilaminectomies (for example, discectomy) were included. Only pa-
Clinical Findings

When the 58 patients were classified into two groups according to age at laminectomy, the incidence of deformity was different (Table 2). Twelve (46%) of the 26 patients aged less than 15 years old developed a deformity and, in eight of these, anterior fusion was needed to reduce and stabilize it. Deformity developed C-1, and C-2, were excluded because the unique structure of these vertebral bodies and their intervertebral ligaments usually does not allow development of postlaminectomy deformity. There were no instances of spinal deformity after laminectomy of C-1 and C-2 in Group A. We believe that this should not be attributed to the smaller number of laminae removed but to anatomic differences. Neither the atlas nor the axis has vertebral bodies that can collapse or end-plates with significant growth potential to cause wedging after laminectomy. The more anterior location of the facet joints also may be a factor.

We also excluded 111 other patients (Group B). Of these, 84 patients had trauma, congenital deformity, spondylolisthesis, von Recklinghausen's disease, or other conditions that may in themselves cause spinal deformity without laminectomy. We2,23,27 The remaining 27 patients in Group B had metastatic malignant tumors, and their life span was too short to evaluate the incidence of spinal deformity. Spinal deformity developed in many patients of this group, but its relationship to laminectomy could not be determined.

The remaining 58 patients (Group C) included those with various diagnoses, none of which commonly produces spinal deformity. The histories and preoperative and postoperative spinal roentgenograms of this group were reviewed to determine age, sex, diagnosis, level and number of laminae removed, type of postoperative deformity, the neurological condition after laminectomy, the length of time from surgery to deformity, and the need for surgical fusion. No patient in this group had a deformity preoperatively. Although deformity after irradiation of the growing spinal column is well known, only one of the 58 patients in this series was given radiation therapy after laminectomy; thus, this variable was not correlated with spinal deformity.

The 248 younger patients (less than 25 years old) were placed into three groups (Table 1). Group A (79 patients), whose laminectomies involved the occiput,
Spinal deformity after multilevel laminectomy

TABLE 3
Patients with deformity after multilevel laminectomy

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age* (yrs), Sex</th>
<th>Primary Disease</th>
<th>No. of Laminae Removed</th>
<th>Postlaminectomy† Neurological Status</th>
<th>Evidence of Deformity (mos)</th>
<th>Deformity on X-Ray Study</th>
<th>Spinal Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients aged less than 15 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1, F</td>
<td>neuroma</td>
<td>5</td>
<td>2</td>
<td>40</td>
<td>wedging (moderate)</td>
<td>yes</td>
</tr>
<tr>
<td>2</td>
<td>4, 10, M</td>
<td>ependymoma</td>
<td>6</td>
<td>1</td>
<td>92,14 (2 operations)</td>
<td>wedging (mild)</td>
<td>no</td>
</tr>
<tr>
<td>3</td>
<td>5, M</td>
<td>Arnold-Chiari malformation, syringomyelia astrocytoma</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>increased mobility</td>
<td>yes</td>
</tr>
<tr>
<td>4</td>
<td>8, M</td>
<td>syringomyelia</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>anterior subluxation of C-2 on C-3 &amp; C-3 on C-4</td>
<td>yes</td>
</tr>
<tr>
<td>5</td>
<td>8, F</td>
<td>glioblastoma</td>
<td>9</td>
<td>2</td>
<td>72</td>
<td>hypertrophic change</td>
<td>yes</td>
</tr>
<tr>
<td>6</td>
<td>10, M</td>
<td>arachnoid cyst</td>
<td>4</td>
<td>2</td>
<td>19</td>
<td>increased mobility</td>
<td>yes</td>
</tr>
<tr>
<td>7</td>
<td>11, F</td>
<td>meningioma</td>
<td>6</td>
<td>2</td>
<td>51</td>
<td>wedging (severe)</td>
<td>yes</td>
</tr>
<tr>
<td>8</td>
<td>13, M</td>
<td>meningioma</td>
<td>3</td>
<td>2</td>
<td>43</td>
<td>increased mobility</td>
<td>yes</td>
</tr>
<tr>
<td>9</td>
<td>13, F</td>
<td>Arnold-Chiari malformation</td>
<td>3</td>
<td>2</td>
<td>27</td>
<td>wedging (moderate)</td>
<td>yes</td>
</tr>
<tr>
<td>10</td>
<td>13, F</td>
<td>arachnoid cyst</td>
<td>4</td>
<td>2</td>
<td>72</td>
<td>subluxation &amp; wedging (severe)</td>
<td>no</td>
</tr>
<tr>
<td>11</td>
<td>14, F</td>
<td>Arnold-Chiari malformation</td>
<td>3</td>
<td>3</td>
<td>55</td>
<td>wedging (moderate)</td>
<td>no</td>
</tr>
<tr>
<td>12</td>
<td>14, M</td>
<td>syringomyelia</td>
<td>6</td>
<td>2</td>
<td>72</td>
<td>loss of lordotic curve, hypertrophic change</td>
<td>no</td>
</tr>
<tr>
<td>Patients aged 15 to 25 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>17, M</td>
<td>intramedullary lipoma</td>
<td>10</td>
<td>1</td>
<td>74</td>
<td>hypertrophic change, decreased intervertebral space</td>
<td>no</td>
</tr>
</tbody>
</table>

* Age at laminectomy.
† Neurological condition after laminectomy: 1 = no deficit; 2 = slight, mild deficit; and 3 = severe deficit or bedridden. First evidence of deformity at x-ray study.

in only two (6%) of the 32 patients aged 15 years or older (Table 3, Cases 13 and 14). Both were male patients, 17 and 18 years old, and had deformities that were mild and did not progress after maturity was reached. Fusion was not necessary in either.

Of the 12 patients with deformity in the younger subgroup, seven had anterior body wedging, three had hypermobility between vertebral bodies, and one had subluxation only (Table 3). The patients with wedging had more severe kyphotic deformity than did the patients with hypermobility between vertebral bodies.

In the younger subgroup of 26 patients, nine patients underwent cervical or cervicothoracic laminectomy, and spinal deformity developed in eight of these (89%). In the one patient for whom we have no postoperative roentgenogram, a subsequent letter noted that kyphosis had developed. Thus, deformity developed after cervical laminectomy in all members (100%) of this subgroup. Of the 11 patients with thoracic laminectomy, four (36%) developed a deformity, but in the remaining seven, follow-up spinal roentgenograms were not taken. Of the six patients with lumbar laminectomy, none had deformity, but three of the six did not have follow-up spinal roentgenograms. Also, no increase of lumbar lordosis was noted in these six patients, a problem that was reported by Ingraham and Matson.11 If the radiographic follow-up studies had been more complete for the patients with thoracic and lumbar laminectomy, the percentage with deformity might have been higher.

No correlation was noted between the incidence of deformity and sex, the number of laminae removed (this agrees with the results of Fraser, et al.8), the neurological condition following laminectomy, or the length of time after surgery. It would seem that the incidence should correlate with the number of laminae removed and possibly with the postoperative neurological status, but the numbers of patients were too small at each level to make a positive correlation.

The first radiographic evidence of deformity occurred between 2 and 74 months after laminectomy. Four patients were first noted to have deformity 6 years after laminectomy.

Discussion

This study was performed by a review of the patients' records, and no attempt was made to contact the patients to request that they return for evaluation.
Some patients who were lost to follow-up review may have developed spinal deformity and may have been treated elsewhere. Thus, the incidence of deformity for thoracic and lumbar laminectomies may be higher than reported in this study.

Our thoughts concerning follow-up examination, prevention, and management of this condition have been published previously.26 Basically, all patients aged less than 25 years who undergo multilevel laminectomy for any reason should be reevaluated at 6 months, 1 year, and each year thereafter for 6 years to watch for the possibility of spinal deformity developing. The evaluation should include posteroanterior and lateral roentgenograms of the entire spinal column. Although our study did not evaluate the use of braces, postoperative bracing may have diminished certain thoracic and lumbar deformities. The brace might have to be worn until maturity of growth. Once spinal deformity is present, it is best corrected or its progression is best arrested by spinal fusion. In our opinion, anterior fusion is generally preferable to posterior fusion for stabilization.

Conclusions

1. The incidence of spinal deformity after multilevel laminectomy (excluding cases involving facetectomy and conditions that might, in themselves, cause deformity) is related to age of the patient and level of the laminectomy. The younger the patient, the more likely the occurrence. None of the adults developed deformity. Six percent of the patients between the age of 15 and 24 years developed deformity. Deformity developed in 46% of growing patients (14 years or younger). If the follow-up period had been longer, the incidence might have been greater.

2. Spinal deformity after multilevel laminectomy is dependent on the level of the laminectomy. The more cephalad the laminectomy, the more likely the occurrence. Deformity developed in 100% of patients with cervical laminectomies, 36% with thoracic laminectomies, and 0% with lumbar laminectomies.

3. No correlation exists between the incidence of deformity and either the sex of the patient, the number of laminae removed, the neurological condition after laminectomy, or the length of time after surgery.

4. Children with cervical and thoracic multilevel laminectomy should be followed by x-ray study for at least 6 years after the operation to ensure that all those who develop spinal deformity are identified.

References


S. Yasuoka, H. A. Peterson and C. S. MacCarty
Spinal deformity after multilevel laminectomy


Manuscript received December 21, 1981. Accepted in final form June 11, 1982.

Address reprint requests to: Shozo Yasuoka, M.D., Section of Publications, Mayo Clinic, Rochester, Minnesota 55905.