Laminoplasty for the treatment of failed anterior cervical spine surgery

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Object. Cervical stenotic myelopathy can be treated via anterior or posterior approaches. In anterior cervical decompression and fusion (ACDF), because the risks and likelihood of pseudarthrosis increase with the number of treated segments, attempts are typically made to limit the number of treated levels. Thus, postoperative recurrence of myelopathy following ACDF may occur because stenotic levels were not treated or because adjacent segments have degenerated. Revision decompressive surgery via an anterior approach is one solution; however, if the stenosis involves multiple levels a posterior decompressive laminoplasty can be performed as an alternative.

Methods. Twenty-four cases treated over an 8-year period were identified and data were retrospectively reviewed. In 15 cases posterior decompressive surgery was necessary because of progressive spinal degeneration and stenosis (five cases following initial treatment for radiculopathy, seven after initial treatment for spondylotic myelopathy, and three due to spreading of an ossified posterior longitudinal ligament). In nine cases revision surgery was undertaken because the initial decompression was inadequate.

The mean follow-up period after the second surgery was 16 months. Improvements in myelopathy were seen in 83% of patients (mean improvement of 1.25 points on the Nurick Scale). Preoperative severe gait disorders were associated with poor recovery. Complications included two cases of transient C-5 nerve root palsy and two cases of new persistent axial neck pain.

Conclusions. Laminoplasty is a straightforward and effective treatment for failed ACDF due to inadequate decompression or progressive degeneration of the spinal column, avoiding reentry through scar tissue. In terms of myelopathic pain, the recovery rate is comparable with that related to revision ACDF.

KEY WORDS • myelopathy • cervical spine • complication • laminoplasty

A basic tenet of the surgical treatment for cervical myelopathy is that the decompressive procedure should target the levels of symptomatic or radiographically documented stenosis. When the region of spinal canal compromise is focal and limited to few segments, ACDF is the preferred treatment option because long-segment fusions are prone to pseudarthrosis.⁵ Limiting the length of the decompression, however, may fail to address all the stenotic levels adequately. Furthermore, degeneration of the spinal column is progressive in nature, and although the initial operation may prove efficacious, symptomatic adjacent-segment stenosis may develop. In fact, spinal fusion may transfer additional mechanical stresses to adjacent motion segments, accelerating spondylotic changes. This can result in further disc herniations, osteophyte formation, and stenosis.

The optimal treatment for residual or recurrent cervical stenosis should address the need for neural decompression,

minimize the risks of a symptomatic pseudarthrosis, and limit the likelihood of approach-related complications. Although ACDF-related revision surgery is optimal for treating a single-level residual or recurrent compression, a second anterior surgery is also hindered by several drawbacks.

First, scarring of the esophagus and other structures in the anterior neck makes the soft-tissue dissection and approach more hazardous, and anterior revision procedures have been found to be associated with a high incidence of dysphagia.³ Accessing the spine via the contralateral side avoids scar tissue but requires an additional cosmetically apparent skin incision. In addition, if the patient suffers from a recurrent laryngeal nerve palsy due to the first surgery, then a contralateral approach is contraindicated. Second, the risk of pseudarthrosis is significantly higher for a revision ACDF. In one series of 24 patients who underwent anterior discectomy and fusion for adjacent-level disease, the second operation was associated with a 37% nonunion rate, and cases of pseudarthrosis were related to poor outcomes.⁹

For these reasons, in selected cases posterior decom-

Abbreviations used in this paper: ACDF = anterior cervical decompression and fusion; OPLL = ossification of the posterior longitudinal ligament.

pression of the cervical cord may be preferable. Contemporary posterior techniques include laminectomy with instrumentation-augmented fusion and expansile laminoplasty. In this report we review our experience with revision of failed ACDF treated with cervical laminoplasty.

CLINICAL MATERIAL AND METHODS

Twenty-four cases in which laminoplasty was performed for failed ACDF were identified over an 8-year period. All cases were treated by the senior author (B.A.G.) at the Department of Neurological Surgery, University of Miami. Data were reviewed retrospectively, and myelopathy was classified according to the Nurick scale.¹⁵ In 15 cases posterior decompressive surgery was necessary because of progressive spinal degeneration due to cervical spondylosis or OPLL and in nine cases because of inadequate initial anterior decompression. The mean follow-up period after the second surgery was 16 months.

Revision surgery consisted of open-door cervical expansive laminoplasty.^{10,12} A C3–7 decompression was performed by drilling troughs at the lamina–facet junction bilaterally and “greenstick” fracturing of the laminae en bloc. Rib allograft spacers measuring 1.2 mm in height were used to support the open-door construct. Attempts were made to avoid formal intersegmental fusion across the entire laminoplasty construct. Patients were maintained in a Miami J collar for 6 weeks postoperatively.

RESULTS

Initial Surgical Management

All patients had undergone ACDF for neural decompression as the initial procedure. In five cases the initial presenting complaint was radiculopathy; the remainder presented with myelopathy. Three patients suffered OPLL-related myelopathy, and 16 suffered CSM (Table 1).

Eight patients had undergone a single-level discectomy, nine a two-level discectomy, two a three-level discectomy, and one had undergone a four-level discectomy; a single-level corpectomy and a two-level corpectomy were conducted in two cases each. Fusion involved instrumentation or no instrumentation at the initial surgery, resulting in successful arthrodesis in all cases.

Revision Surgery

The five patients treated initially for symptoms of radiculopathy all experienced initial improvement. New myelopathic symptoms developed due to subsequent disc herniations, however, prompting additional treatment. This occurred a mean of 26 months after the first surgery (range 12–42 months). New disc herniations causing cord compression were seen at two new levels in three patients and three new levels in two patients. In the three patients with only two-level stenosis, dysphagia or vocal cord paresis was the primary indication for a posterior approach. All five patients underwent a C3–7 laminoplasty. Nurick grades determined just prior to the second surgery averaged 2.4, which improved to an average of 1 at last follow up.

In the 19 patients who initially presented with myelopa-

thy, improvement was demonstrated after the first surgery in 10. Neurological deterioration subsequently occurred due to progression of spinal spondylosis or OPLL causing recurrent spinal stenosis. This developed a mean of 34 months after the first surgery (range 13–67 months). In all cases the neurological status at the time of the second surgery was worse than at initial presentation, and the patient had lost all of the functional gains achieved after the anterior surgery. Eight patients underwent a C3–7 laminoplasty, and two underwent an additional T-1 laminectomy to decompress the C7–T1 level. Overall, the mean Nurick grade was 2.6 at initial presentation, 3.2 at the time of laminoplasty, and 1.9 after the laminoplasty procedure for these 10 patients.

In the remaining nine patients, the first surgery failed to address the original spinal cord compression, leading to a worsening or unchanged neurological state. This prompted postoperative imaging studies, which underscored the need for the second surgical procedure. The second surgery was undertaken a mean of 14 months after the first surgery (range 2–78 months). In these cases the first surgery either did not decompress an adequate number of spinal levels or involved discectomies in which significant interspace cord compression was present. All nine patients underwent a C3–7 laminoplasty. The mean overall Nurick grade was 2.9 at initial presentation, 3.1 at the time of laminoplasty, and 2 after the laminoplasty for these 10 patients.

Procedural Complications

Two patients developed a postlaminoplasty C-5 nerve root palsy, and the weakness eventually resolved over 3 to 5 months. Two patients also developed new persistent axial neck pain after laminoplasty, but this was not found to be associated with neural compression or abnormal spinal motion on dynamic radiography.

DISCUSSION

Interbody fusion of spinal motion segments results in increased strain on adjacent segments, accelerating the spondylotic changes at those levels.¹⁴ In one series of 374 patients treated with ACDF, Kaplan–Meier analysis suggested that up to 25% of patients will develop adjacent-segment neural compression,⁸ and authors of long-term studies have identified a 7 to 15% reoperation rate.^{1,2,7,13} As the number of patients undergoing ACDF and the mean longevity of patients increase, the prevalence of adjacent-segment disease will undoubtedly increase.

Although the optimal treatment for adjacent-area stenosis limited to one or two levels is typically a revision ACDF, multiple levels of compression may be better treated via a posterior approach. In this study we found that laminoplasty was effective for treating residual or recurrent cervical stenotic myelopathy due to spondylosis or OPLL. The mean number of stenotic levels at the time of the second surgery was 2.9 (range two–four). Thus, a posterior decompression was chosen. No patient suffered worsening neurological function, and gait improved in 83% according to Nurick grade. Severe debilitating myelopathy prior to the posterior surgery was associated with the absence of clinical improvement.

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TABLE 1
Summary of data in 24 patients requiring revision cervical decompression*

Age (yrs), at 2nd Op, Sex	Initial Presen- tation	1st Op	2nd Presen- tation	Mos Between Ops	Levels of Stenosis at 2nd Op	2nd Op†	Nurick Grade			Dis- charge	FU (mos)	Compli- cations
							Ini- tial	Before 2nd Op	FU			
69, M	radicu- lopathy	C5–6 ACDF	new myelopathy from ALDHs	12	C4–6	rt C3–7	0	3	1	home	9	persistent pain‡
63, M	cervical spon- dylosis	C4–6 ACDF	recurrent my- elopathy from ALDHs	32	C3–4, C6–7	lt C3–7	2	3	2	home	13	none
31, M	trauma, then ad- jacent disease	C4–5 ACDF	progressive myelop- athy due to con- genital stenosis un- treated by 1st op	8	C3–7	rt C3–7	5	5	5	rehab	42	none
50, M	cervical spon- dylosis	C4–6 ACDF	initial op failed to address steno- sis at all levels	4	C3–4, C6–7	rt C3–7	3	3	1	home	40	transient C-5 root palsy
81, M	cervical spon- dylosis	C-4 cor- pectomy	recurrent my- elopathy from ALDHs	27	C5–7	rt C3–7	5	5	5	rehab	14	none
41, M	cervical spon- dylosis	C5–7 ACDF	recurrent my- elopathy from ALDHs	13	C3–5, C7–T1	rt C3–T1	2	3	1	home	6	none
69, M	cervical spon- dylosis	C3–5 ACDF	initial op failed to address steno- sis at all levels	4	C3–7	rt C3–7	2	2	1	home	12	none
77, F	cervical spon- dylosis	C3–7 ACDF	progressive myelop- athy due to con- genital stenosis un- treated by 1st op	7	C3–7	lt C3–7	2	3	2	rehab	13	none
78, M	OPLL	C-4 cor- pectomy	progressive OPLL involving multi- levels	13	C-3, C5–6	lt C3–7	3	3	1	home	48	none
55, M	radicu- lopathy	C4–5 ACDF	new myelopathy from ALDHs	42	C3–7	lt C3–7	0	2	1	home	3	none
57, F	cervical spon- dylosis	C4–6 ACDF	initial op failed to address steno- sis at all levels	78	C3–7	lt C3–7	3	3	3	rehab	12	none
64, M	cervical spon- dylosis	C4–7 ACDF	progressive myelop- athy due to con- genital stenosis un- treated by 1st op	6	C4–6	rt C3–7	3	2	1	home	6	none
57, F	OPLL	C-4 & 5 corpec- tomies	progressive OPLL involving multi- levels	39	C-3, C6–7	rt C3–7	3	3	2	home	12	axial neck pain
51, M	cervical spon- dylosis	C4–6 ACDF	progressive myelop- athy due to con- genital stenosis un- treated by 1st op	4	C3–6	lt C3–7	2	3	2	home	13	none
73, F	cervical spon- dylosis	C4–6 ACDF	progressive myelop- athy due to con- genital stenosis un- treated by 1st op	11	C4–7	rt C3–7	3	4	2	rehab	2	None
40, M	radicu- lopathy	C4–5 ACDF	new myelopathy from ALDHs	37	C3–4, C5–7	rt C3–7	0	2	1	home	12	axial neck pain
54, F	cervical spon- dylosis	C4–7 ACDF	myelopathy im- proved, plateaued, then recurred due to progressive mul- tifactorial stenosis	67	C4–7	rt C3–7	2	3	1	home	36	none
46, F	radicu- lopathy	C5–6 ACDF	new myelopathy from ALDHs	19	C3–4, C4–5	rt C3–7	0	2	1	home	32	none
90, M	cervical spon- dylosis	C3–5 ACDF	recurrent myelop- athy from ALDHs	27	C2–3, C5–7	lt C2–7	2	2	2	home	12	none
45, M	cervical spon- dylosis	C5–6 ACDF	recurrent myelop- athy from ALDHs	48	C3–4, C6–7	rt C3–7	2	2	1	home	8	none

TABLE 1, Continued
Summary of data in 24 patients requiring revision cervical decompression*

Age (yrs), at 2nd Op, Sex	Initial Presen- tation	1st Op	2nd Presen- tation	Mos Between Ops	Levels of Stenosis at 2nd Op	2nd Op†	Nurick Grade			Dis- charge	FU (mos)	Compli- cations
							Ini- tial	Before 2nd Op	FU			
43, M	OPLL	C-6 cor- pectomy	progressive OPLL involving multi- levels	42	C4-5	lt C3-7	2	4	2	rehab	3	none
54, M	radicu- lopathy	C5-6 ACDF	new myelopathy from ALDHs	22	C4-5, C6-7	lt C3-7	0	3	1	home	7	none
66, F	cervical spon- dylosis	C5-7 ACDF	new myelopathy from ALDHs	33	C3-4, C7-T1	lt C3-T1	3	4	2	rehab	22	none
69, M	cervical spon- dylosis	C5-6 ACDF	initial op failed to address ste- nosis at all levels	2	C4-7	rt C3-7	3	3	1	home	9	none

* ALDH = adjacent-level disc herniation; FU = follow up; rehab = rehabilitation facility.

† All procedures were laminoplasties.

‡ Persistent lower-extremity neuropathic pain.

When laminoplasty is chosen as a revision procedure, the challenges posed by operating through scar tissue are avoided and the risk of damaging vital structures in the anterior neck is eliminated. Formal arthrodesis is also no longer required. The troubling complications of deltoid palsy and new axial neck pain, however, were each found in two patients postoperatively (with incidences ranging from 5–14%,^{4,6,16,17} up to 25%,¹¹ respectively).

The major drawbacks of this study are its retrospective design and the lack of a comparison cohort. Because the complications associated with ACDF and laminoplasty as a second surgery are different, comparisons remain difficult. The recovery rate associated with myelopathy, however, is similar to that after revision ACDF.⁸

CONCLUSIONS

Laminoplasty is a straightforward and effective treatment for failed ACDF due to inadequate decompression or progressive degeneration of the spinal column, avoiding the need for surgical reentry through scar tissue. The recovery rate associated with myelopathy is comparable with that after revision ACDF.

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