Incidence of Unintended Durotomy in Spine Surgery Based on 108 478 Cases

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BACKGROUND: Unintended durotomy is a common complication of spinal surgery. However, the incidences reported in the literature vary widely and are based primarily on relatively small case numbers from a single surgeon or institution.

OBJECTIVE: To provide spine surgeons with a reliable incidence of unintended durotomy in spinal surgery and to assess various factors that may influence the risk of durotomy.

METHODS: We assessed 108 478 surgical cases prospectively submitted by members of the Scoliosis Research Society to a deidentified database from 2004 to 2007.

RESULTS: Unintended durotomy occurred in 1.6% (1745 of 108 478) of all cases. The incidence of unintended durotomy ranged from 1.1% to 1.9% on the basis of preoperative diagnosis, with the highest incidence among patients treated for kyphosis (1.9%) or spondylolisthesis (1.9%) and the lowest incidence among patients treated for scoliosis (1.1%). The most common indication for spine surgery was degenerative spinal disorder, and among these patients, there was a lower incidence of durotomy for cervical (1.0%) vs thoracic (2.2%; $P = .01$) or lumbar (2.1%, $P < .001$) cases. Scoliosis procedures were further characterized by etiology, with the highest incidence of durotomy in the degenerative subgroup (2.2% vs 1.1%; $P < .001$). Durotomy was more common in revision compared with primary surgery (2.2% vs 1.5%; $P < .001$) and was significantly more common among elderly (> 80 years of age) patients (2.2% vs 1.6%; $P = .006$). There was a significant association between unintended durotomy and development of a new neurological deficit ($P < .001$).

CONCLUSION: Unintended durotomy occurred in at least 1.6% of spinal surgeries, even among experienced surgeons. Our data provide general benchmarks of durotomy rates and serve as a basis for ongoing efforts to improve safety of care.

KEY WORDS: Complications, Durotomy, Scoliosis, Spine surgery, Spondylolisthesis

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Unintended durotomy is a common complication of spinal surgery. The incidences reported in the literature vary widely and are based primarily on relatively small case numbers from a single surgeon or institution.[1-28] Reported incidences of durotomy vary, depending on the type and complexity of procedure: lumbar decompression, 8.5% to 14%[7,14,23]; diskectomy, 0.2% to 5.9%[3-5,7,9,11,16,22,23,25]; reoperation, 8.1% to 17.4%[4,5,7,11,19,23,29]; and instrumentation, 0% to 35%.[1,8,20,21,28] Several factors have been associated with durotomy, including surgeon experience,[27] revision spinal surgery,[2,4,5,7,13,19,23] previous irradiation,[30] and age.[2,14] Typically, durotomy is treated primarily during surgery or managed postoperatively with flat bed rest that may include subarachnoid drain placement; however, despite these measures, some patients require surgical revision.[3,7,31-37] Complications resulting from dural tears include cerebrospinal fluid leak or fistula[6,35,38,39]; meningitis,[39,40]

ABBREVIATION: **SRS,** Scoliosis Research Society arachnoiditis, or spinal epidural abscess[39-44]; psuedomeningocele[37,38,45-48]; intracranial or intraspinal hemorrhage[49-51]; and headache.[44,45,47,52]

The Scoliosis Research Society (SRS) routinely collects morbidity and mortality data from its members, which provide a wealth of data from experienced spine surgeons. The purpose of this study is to provide spine surgeons with a reliable incidence of unintended durotomy in spinal surgery and to assess various factors that may influence the risk of durotomy.

MATERIALS AND METHODS

The SRS morbidity and mortality database is the compilation of submissions of SRS members around the world, the majority of whom reside in North America. For the years the data were collected and reviewed for this report, candidate members had a mandatory requirement to report their morbidity and mortality results. Full active members were strongly encouraged to report their results.

To assess the incidence of unintended durotomy, all reported surgical cases from 2004 through 2007 were extracted from the SRS database. All data had previously been deidentified of any information regarding the patient, surgeon, or institution. This project was submitted to the Hospital for Special Surgery (New York, New York) Institutional Review Board and was deemed to be exempt from Institutional Review Board approval on the basis of the use of deidentified data (Institutional Review Board No. 29045).

In addition to evaluating whether an unintended durotomy occurred, other parameters analyzed included patient age, diagnosis, whether the surgery was primary or revision, presence or absence of preoperative neural compression, whether and how fusion was performed, whether instrumentation was used, whether surgery was performed using a minimally invasive approach, membership status of the surgeon (active, candidate, international), and whether an associated neurological complication occurred.

The overall incidence of unintended durotomy was tabulated and stratified further on the basis of clinical and surgical factors. Statistical analysis of these data was performed with SPSS for Windows version 15.0 (SPSS Inc, Chicago, Illinois). The 2-proportion Z test (2 tailed with unequal variances) was used when a Clopper Pearson distribution was approximated by a normal distribution. If a normal distribution did not approximate the data accurately, then the Fisher exact test was used. For analysis of 2 means, the 2-sample unpooled t test was used. Unless otherwise specified, a 2-proportion Z test was used. Statistical significance was based on a value of $P < .05$.

RESULTS

A total of 108 478 surgical cases were reported to the SRS database from 2004 through 2008, including 76 798 (71%) from active members, 25 004 (23%) from candidate members, 6533 (6%) from international members, and 143 (0.1%) lacking designation of membership status. The overall mean patient age was 47 years (median, 48 years; range, 1 month-97 years), and the most common preoperative diagnoses included degenerative spinal disorder (44% of cases), scoliosis (24% of cases), and spondylolisthesis (11% of cases; Table 1).

The overall incidence of unintended durotomy was 1.6% (1745 of 108 478). Based on primary diagnosis, the incidence of unintended durotomy ranged from 1.1% among patients treated for scoliosis to 1.9% among patients treated for kyphosis or spondylolisthesis (Table 1).

Degenerative spinal disorders were further characterized by subtype and spinal level (Table 2). The incidence of durotomy based on degenerative disease subtype ranged from 1.0% among

TABLE 1. Incidence of Unintended Durotomy Based on Primary Diagnosis[a]

Primary Diagnosis	Cases, n	Durotomies, n	Incidence of Durotomy, %
Kyphosis	3599	68	1.9
Spondylolisthesis	11 421	214	1.9[a]
Degenerative spinal disorder	47 399	852	1.8[a]
Other	12 456	216	1.7
Not recorded	475	7	1.5
Fracture	6704	92	1.4
Scoliosis	26 424	296	1.1[a]
Total	108 478	1745	1.6

[a]Spondylolisthesis and degenerative spinal disorder had significantly higher rates of durotomy compared with the overall rate ($P = .026$ and $P < .001$, respectively), and scoliosis had a significantly lower rate ($P < .001$).

TABLE 2. Incidence of Unintended Durotomy Among Patients With a Primary Diagnosis of Degenerative Spinal Disease, Stratified Based on Subtype of Degenerative Disease and Spinal Location

	Durotomies, n	Cases, n	Incidence of Durotomy, %
Subtype of degenerative disease			
Not recorded	17	614	2.8
Degenerative disk disease	234	9256	2.5[a]
Spondylotic radiculopathy	58	2861	2.0
Spinal stenosis	273	16 036	1.7
Disk herniation	264	18 008	1.5[a]
Lumbar postlaminectomy syndrome	6	624	1.0
Total	852	47 399	1.8
Degenerative spinal disorder level			
Thoracic	12	552	2.2[b]
Lumbar	721	34 731	2.1[b]
Not recorded	7	334	2.1
Cervical	112	11 782	1.0
Total	852	47 399	1.8

[a]Degenerative disk disease had a significantly higher rate of durotomy compared with the degenerative disease group ($P < .001$), and disk herniation had a significantly lower rate ($P < .001$).

[b]Cervical vs thoracic location had a significantly lower rate of durotomy ($P = .01$, Fisher exact test), as well as cervical vs lumbar ($P < .001$).

patients treated for lumbar postlaminectomy syndrome to 2.5% among patients treated for degenerative disk disease. The most common subgroups of degenerative spinal disease were disk herniation (n = 18 008) and spinal stenosis (n = 16 036), which had durotomy incidences of 1.5% and 1.7%, respectively. Among procedures performed for degenerative disease, cervical procedures were found to have a less frequent association with durotomy (1.0%) compared with thoracic (2.2%; $P = .01$) and lumbar (2.1%; $P < .001$) procedures (Table 2).

Scoliosis cases were also characterized by etiology of the deformity. The most frequent type of scoliosis in this series was idiopathic (n = 14 296), followed by neuromuscular (n = 5191) and degenerative (n = 2577; Table 3). The incidence of unintended durotomy ranged from 0.9% to 2.2% among patients treated for idiopathic and degenerative scoliosis, respectively. The incidence of durotomy was significantly higher for degenerative scoliosis cases compared with scoliosis cases that were not degenerative ($P = .001$).

The mean age of patients with durotomy was 56 years (median, 55; range, 1 month to 95 years), which was significantly older than patients who did not have durotomy ($P < .001$, Student t test). When stratified by patient age, the incidence of durotomy varied from a minimum of 1.1% (43 of 3791) among patients 0 to 9 years of age to a maximum of 2.2% (81 of 3602) in those > 80 years of age (Table 4).

Multiple surgical and radiographic parameters were assessed for association with unintended durotomy occurrence (Table 5). The incidence of durotomy did not differ significantly based on whether the procedure did or did not include spinal fusion (1.6% and 1.7%, respectively; $P = .3$). Among the 72 691 cases that included fusion, the incidence of unintended durotomy was significantly higher for posterior lumbar interbody fusions (2.2% vs 1.6%; $P < .001$) and for posterolateral fusions (2.0% vs 1.6%; $P = .001$). Anterior-only fusions had a significantly lower incidence of durotomy (1.0%; $P < .001$). Furthermore, the use of instrumentation did not result in more durotomies; there were more durotomies in the group without instrumentation (1.5% with vs 1.8% without instrumentation; $P = .002$; Table 5).

TABLE 3. Incidence of Unintended Durotomy Based on Scoliosis Subtype

Scoliosis Subtype	Cases, n	Durotomies, n	Incidence of Durotomy, %
Degenerative	2577	57	2.2[a]
Congenital	2198	31	1.4
Other	1959	21	1.1
Neuromuscular	5191	53	1.0
Not recorded	203	2	1.0
Idiopathic	14 296	132	0.9[a]
Total	26 424	296	1.1

[a]Incidence of durotomy for degenerative scoliosis cases was significantly greater compared with all scoliosis cases ($P < .001$) and significantly lower for idiopathic scoliosis cases ($P = .001$).

TABLE 4. Incidence of Unintended Durotomy in Spine Surgery Based on 108 478 Cases, Stratified by Patient Age

Patient Age, y	Cases, n	Durotomies, n	Incidence of Durotomy, %
0-9	3791	43	1.1[a]
10-19	16 162	282	1.7
20-39	17 209	265	1.5
40-59	38 769	560	1.4
60-79	28 029	503	1.8
>80	3602	81	2.2[a]
Age not recorded	916	11	1.2
Total	108 478	1745	1.6

[a]The 0- to 9-year-old group had a significantly lower incidence of durotomy compared with the overall rate ($P = .005$), and the > 80-year-old group had a significantly higher rate ($P = .006$).

Revision surgery was associated with a significantly greater (almost 1.5 times) incidence of unintended durotomy (2.2%) compared with primary surgery (1.5%; $P < .001$; Table 5). There was no difference in the incidence of durotomy between open (1.6%) and minimally invasive (1.6%; $P = .9$) techniques. In addition, the incidence of durotomy did not differ significantly between cases with or without preoperative neural compression (1.6% and 1.7%, respectively; $P = .06$; Table 5). Furthermore, the incidence of durotomy did not differ depending on physician experience, with active members presumably having more and candidate members presumably having less experience (1.6% and 1.5% incidence, respectively; $P = .9$; Table 5).

Of the 1745 patients with an unintended durotomy, 78 (4.5%) had a postoperative neurological deficit compared with a postoperative neurological deficit rate of 1.6% for patients who did not have an unintended durotomy ($P < .001$). Of the 78 neurological deficits in patients with incidental durotomies, 37 (47%) occurred within 24 hours of surgery, 22 (28%) occurred > 24 hours after surgery, 18 (23%) occurred intraoperatively, and the development of 1 (1%) was not recorded. There were 55 nerve root injuries. Of these, 17 patients (31%) had complete resolution of their symptoms, 35 (64%) had partial resolution, 1 (2%) experienced no recovery, and 2 (4%) were not recorded. There were 7 cauda equina injuries; subsequently, 4 patients (57%) had complete resolution of their symptoms, 2 (29%) had partial resolution, and 1 (14%) was not documented. There were 13 incomplete spinal cord injuries, of which 5 (38%) had complete and 8 (62%) had partial resolution of symptoms. There was 1 complete cord injury that did not improve.

DISCUSSION

Unintended durotomy is one of the most common complications of spinal surgery, with an incidence ranging from 0.2% to 17%

TABLE 5. Summary of Surgical and Radiographic Characteristics Assessed for Association With Durotomy[a]

	Cases, n	Durotomies, n	Incidence of Durotomy, %	P
Spinal fusion performed				
Yes	72 691	1147	1.6	.3
No	35 782	598	1.7	
Not recorded	5	0	0	
Type of fusion[b]				
PLIF	14 896	332	2.2	<.001
Posterolateral	9991	200	2.0	<.001
TLIF	7089	128	1.8	0.1
Anterior-posterior	8156	125	1.5	0.7
Interlaminer/facet	16 192	213	1.3	<.001
Anterior only	15346	146	1.0	<.001
Not recorded	1021	3	0.3	
Total	72 691	1147	1.6	
Instrumentation				
Yes	74 121	1130	1.5	.002
No	34 313	615	1.8	
Not recorded	44	0	0	
Revision surgery				
Yes	16 502	355	2.2	<.001
No	91 918	1390	1.5	
Minimally invasive approach[c]				
Yes	14 301	227	1.6	.8
No	94 177	1518	1.6	
Preoperative neural compression				
Yes	66 457	1032	1.6	.06
No	41 936	713	1.7	
Member status				
Active member	76 798	1224	1.6	.4
Candidate member	25 004	378	1.5	

[a]PLIF, posterior lumbar interbody fusion; TLIF, transforaminal lumbar interbody fusion.
[b]Note that posterior lumbar interbody fusion and posterolateral fusion are associated with significantly greater incidences of durotomy, whereas anterior-only and interlaminer surgery is associated with a significantly lower incidence of durotomy.
[c]The 227 durotomies encountered with minimally invasive procedures were with the following procedures: kyphoplasty/vertebroplasty (n = 8), mini-open (n = 139), other minimally incisional (n = 78), and thoracoscopic (n = 2).

(Table 6).[1-28] The overall incidence of durotomy in our series, 1.6%, is consistent with previously published literature. The rate of durotomy for diskectomy including all levels, cervical, thoracic, and lumbar, was 1.5%. This is consistent with previous literature for diskectomy, which is composed primarily of lumbar diskectomy with rates ranging from 0.2% to 5.9%.[3-5,7,9,11,16,22,23,25]

We confirm that revision cases have a significantly higher incidence of durotomy, which has been reported previously.[2,4,7,11] We also show that older patients have a higher incidence of durotomy.[2] However, in this study, the relationship does not appear to be linear and may represent an effect caused by confounding variables such as the indication for surgery and the type of procedure performed. Certainly, in an older cohort of patients, degenerative spinal disease predominates, whereas in a younger sample, scoliosis and trauma are more common. These variations in pathology alter the goal of surgery and the type of procedure performed. All these variables could affect the incidence of durotomy in our study. Furthermore, we demonstrate that durotomy in this series has a statistically significant association with the development of new postoperative neurological deficit, which usually occurred within the first 24 hours after surgery. Recovery from these injuries was either partial or complete in the vast majority of cases. The relationship may seem intuitive in that one primary mode of neural injury is direct trauma, which may involve penetration of the dura to reach the neural elements. However, we must iterate that this study cannot demonstrate a causative relationship between these 2 events but merely an association. It is equally likely that the association is due to other factors not evaluated. Other sequelae related to dural tears, not assessed in the present series, are rare but may be severe, including meningitis or pseudomeningocele.[37-40,45-47]

The overall incidence of durotomy with scoliosis surgery in the present series was 1.1%, with a range of incidences depending on the etiology of scoliosis. In a prior report of the SRS regarding adolescent idiopathic scoliosis, the overall incidence of durotomy was 0.18% (12 of 6339), whereas our incidence in a similar group of idiopathic scoliosis was 0.9%. The higher incidence may be due to variations in patient population or procedure characteristics[12] or may simply reflect greater diligence in reporting.

Surprisingly, in the present series, surgery without instrumentation had a higher incidence of durotomy than did surgery with instrumentation. Although instrumentation may be more technically demanding, the higher rate of durotomy in uninstrumented patients could be attributed to a greater focus on decompression, which could impose a greater risk of durotomy.

Among the instrumented cases, the rate of durotomy was significantly greater with posterior lumbar interbody fusion compared with transforaminal lumbar interbody fusion. This may be due to the more aggressive retraction of the thecal sac required to access the disk space in a posterior lumbar interbody fusion compared with the transforaminal lumbar interbody fusion approach, which is based on a more lateral approach with less thecal sac retraction.[18,28,53]

In the present study, the experience of the surgeon as indicated by member status did not result in a higher incidence of durotomy for the less experienced surgeons. Wiese et al[27] compared the incidence of durotomy between surgeons who had performed 50 to 100 and those who performed > 500 microdisketomies and demonstrated a higher incidence of durotomy in the former group (Table 6). Although not specifically assessed, the vast majority of candidate members of the SRS are fellowship-trained spine surgeons dedicated to the treatment of complex spinal conditions. This may contrast with the less experienced group described in the study of Wiese et al.

The present study has several strengths. This is the largest study to date to evaluate unintended durotomy in a broad range of spine surgeries in a group of dedicated spine surgeons. Furthermore, because all of these cases were submitted during

TABLE 6. Summary of Prior Reports of the Incidence of Durotomy in Spine Surgery[a]

Author	Patient Population	Cases, n	Durotomy, % (n/N)	Comments
Mayfield et al, 1975[34]	Laminectomy	1408	0.3	This is the CSF fistula incidence requiring reoperation
Oppel et al, 1977[55]	Lumbar disk herniation	3038	5.9 (179/3038)	
Jones et al, 1989[4]	Lumbar spine surgery	450	3.7 (17/450)	4 Dural tears were in revision cases
Bertalanffy et al, 1989[9]	Anterior cervical diskectomy	450	0.2 (1/450)	
Stolke et al ,1989[5]	Lumbar disk surgery	481	Microdiskectomy, 1.8 (222); macrodiskectomy, 5.3 (190); revision, 17.4 (69)	
Waisman and Schweppe, 1991[6]	Lumbar spine surgery	151	5.3 (8/151)	Only CSF leaks reported, not durotomy
West et al ,1991[8]	Transpedicular variable screw plate fixation	124	5.4 (7/124)	
Davne et al, 1992[1]	Lumbar transpedicular instrumentation	486 Patients, 553 procedures	Not reported	Occurred "occasionally"; all were repaired primarily.
Wang et al ,1998[7]	Lumbar spine surgery	641	14 (88/641)	2 Persistent CSF leaks with 1 requiring revision; 45 durotomies were in revision cases
Cammisa et al, 2000[11]	All spine surgery	2144	Overall, 3.1 (66/2144): cervical (2 of 422), thoracic (0/7), and lumbosacral (64/1715)	
Rosenberg and Mummaneni, 2001[21]	TLIF at L4-5 and L5-S1	22	4.5 (1/22)	
Wiese et al, 2004[27]	Primary lumbar microscopic disk surgery	Retrospective, 1872; prospective, 90	Experienced (> 500 cases): retrospective, 0.8 (932); prospective, 0 (45); not experienced (50-100 cases): retrospective, 7.3 (930); prospective, 4 (45)	Retrospective arm of study with 1872 patients and 90 prospective controlled patients
Saxler et al, 2005[22]	Lumbar disk surgery	1280	3 (41/1280)	Durotomy patients were more likely to have surgery again, increased back pain, and longer time to return to work
Tafazal and Sell, 2005[23]	Lumbar spine surgery	1549	Primary disk, 3.5 (31/872); revision, 13.2 (14/106); spinal stenosis, 8.5 (48/571)	
Khan et al, 2006[19]	Degenerative lumbar spine surgery	3183	Primary, 7.6 (153/2024); revision, 15.9 (185/1159)	6 Required reoperation
Epstein, 2007[14]	Lumbar multilevel laminectomy with noninstrumented fusion in geriatric patients	110	9 (10/110)	Predictive factors included age (74 vs 69 y), ossification of ligamentum flavum, and presence of synovial cyst
Fountas et al, 2007[16]	Primary ACDF for degenerative disk disease or cervical spondylosis	1015	0.5 (5/1015)	
Than et al, 2007[24]	1-Level PLIF	61	Minimally invasive, 0 (0/32); open, 0 (0/29)	

(Continues)

TABLE 6. *Continued*				
Author	**Patient Population**	**Cases, n**	**Durotomy, % (n/N)**	**Comments**
Wang et al, 2007[25]	Cervical spine surgery for degenerative disease	932 009	0.13	Incidence of durotomy was not reported; this is the CSF leak or fistula rate
Rodriguez-Olaverri et al, 2008[20]	Lumbosacral spondylolisthesis	40	TLIF, 35 (7/20); pedicular transvertebral screw fixation, 5 (1/20)	
Yan et al, 2008[28]	Comparison of PLIF and TLIF	187	PLIF, 0 (0/91); TLIF, 0 (0/96)	
This study, 2009	All spine surgery	108 478	1.6	

[a]ACDF, anterior cervical diskectomy and fusion; CSF, cerebrospinal fluid; PLIF, posterior lumbar interbody fusion; TLIF, transforaminal lumbar interbody fusion.

a recent 4-year period, they likely reflect a relatively current standard of care.

Nevertheless, several limitations of this study remain. There currently is no method to determine the completeness of data submission and the accuracy of reporting; they are dependent on the efforts of the participants. Thus, there are limitations to the data integrity, as there is with any large data set. All members of the SRS are concerned about morbidity and mortality and look to the SRS to discern new trends and to identify risks and risk factors for significant complications. There have been 2 previously published articles using the SRS morbidity and mortality database. Because complications like new neurological deficits from surgery for adolescent idiopathic scoliosis are rare, it takes large data sets to capture these events. A similarly rare complication, the occurrence of acute ischemic optic neuropathy associated with prone spine procedures, was also evaluated through the SRS.[12,54]

Although the reported incidence of durotomy likely represents a lower estimate than what would be shown in a prospective clinical trial, it is our opinion that durotomy is probably reliably reported within the database. It typically occurs acutely and has the full attention of the treating surgeon when it occurs. So we suspect that recall bias in the reporting is limited, but we cannot prove or disprove this opinion.

Although it is possible that this data set may have the bias of selective reporting, we believe that it represents a cross section of practicing clinicians. Although there is the possibility that it may have the bias of having greater reporting from younger surgeons in their candidate period and could represent somewhat of a worst-case analysis, there are very senior surgeons reporting as well. In addition, although data are reported prospectively, this is a retrospective study and thus is subject to the weaknesses inherent to such investigations, including confounding variables and reporting bias.

CONCLUSION

Durotomy occurs in at least 1.6% of spinal surgeries, even among experienced spine surgeons. The incidence varies with age, pathology, surgical approach, and operative variables. Although new neurological deficit associated with durotomy occurred in the minority of cases, the present series demonstrates a statistically significant association between these 2 complications. Our data provide general benchmarks of durotomy rates based on preoperative diagnosis and surgical and clinical parameters and serve as a basis for ongoing efforts to improve safety of care.

Disclosure

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

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COMMENT

This group of authors has mined the incredibly large database of spine surgeries compiled by the Scoliosis Research Society. The authors correctly point out that the major weakness of this study, despite its impressively large numbers, is that data reporting was largely voluntary and there was no way to independently validate the completeness or accuracy of data submitted. It would have been interesting to know the number of surgeons whose data were included and the range of durotomy incidence reported by individual surgeons. The database did not specify how many of these durotomies were detected at the time of surgery or whether some became evident later as low-pressure headaches, cerebrospinal fluid leaks, pseudomeningocele, etc.

Most experienced spine surgeons will not be surprised that they report higher frequencies of durotomy in degenerative spine disease, lumbar surgery, revision surgery, and interbody vs lateral spine fusions or that the greater frequency of durotomy in very elderly patients likely was due to the greater frequency of degenerative disease. I was personally somewhat surprised that the incidence was not higher in patients with lumbar spinal stenosis. Interestingly, although a total of 16 502 cases were performed for "revision surgery," only 624 of these cases were performed for lumbar postlaminectomy syndrome (< 4% of the revisions).

This study reports that 4.5% of patients with unintended durotomy developed a postoperative neurological deficit, 3 times greater than the frequency in patients without durotomy. Only 2 of the 75 durotomy patients with deficits available for follow-up failed to improve, but 61% of those with deficits recovered only partially, and the patient with "complete cord injury" did not recover. Unfortunately, their database did not include whether there were cases with meningitis or pseudomeningocele, both of which are definitely potential complications of durotomy and by themselves may cause new postoperative deficits, or whether the extent or severity of the durotomy influenced the frequency of associated neurological deficits. The incidence of aggravated pain, with or without deficit, was not stated. Likewise, the mechanism of injury that caused the durotomy was not stated but undoubtedly influenced these bad results.

If we can accept the accuracy of the data presented, the incidence of unintended durotomy is commendably low in this series. Granted that most of these surgeons are experienced spine surgeons, most having undergone spine fellowships, these data should serve as a benchmark for surgeons less experienced and less dedicated to spine surgery. I would add, however, a comment that I have frequently made to my residents, "Creating an unintended durotomy without injuring neurological tissue—especially in an elderly patient with adherent lumbar dura thinned by spinal stenosis—is not really a complication, but failing to recognize that you have created a durotomy and not repairing it is much more problematic."

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