TECHNICAL NOTE

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Laminectomy performed using a micro bone saw

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Abstract In 154 clinical cases requiring laminectomy at any part of the spinal column, the laminae were removed using a micro bone saw. Immediately after the laminectomy two surgeons using a microscope examined the field for any damage to the dura, the spinal cord, the nerve roots and the epidural vessels. No injury to the spinal cord or the nerve roots was observed. In 5 patients the dura were lacerated for a length of up to 10 mm, and in all the patients adhesions were present due to previous operations. Epidural vessels were severed in 18 cases. The method is useful and less time-consuming than conventional laminectomy.

Résumé Dans 150 cas nécessitant une laminectomie vertébrale, les lames furent coupées à la scie en utilisant une micro-scie à os. Immédiatement après cette laminectomie, deux chirurgiens ont étudiés à l'aide d'un microscope, le champs opératoire pour rechercher des dommages de la dure-mère, de la moelle épinière, des racines nerveuses ou des vaisseaux épiduraux. Aucune atteinte de la moelle épinière ou des racines nerveuses ne furent observées. Dans 5 cas, la dure-mère a été trouvée déchirée sur une longueur maximum de 10 mm. Dans ces cas, des adhérences étaient présentes entre la lame et la dure-mère. Les vaisseaux épiduraux furent altérés dans 18 cas. Cette méthode de laminectomie est très utile, notamment par le gain de temps.

Introduction

In spinal operations laminectomy can be time consuming. The purpose of this technical article is to describe a method of en bloc laminectomy using a micro bone saw, based on the authors' personal experience in 154 clinical cases.

Materials and methods

Preoperatively the thickness of the lamina at the site to be resected is measured by computerised tomography (CT) scan. After carefully detaching the paravertebral muscles, the ligamentum flavum at the caudal side of the lamina to be resected is transected. Next, the adjacent spinal processes rostral and caudal to the intended lamina are resected with a cutter. Using a micro bone saw (Depuy Ace Medical, Warsaw, Indiana, USA) a cut is made from the aspect medial to the facet joint capsule to the median aspect in a slightly diagonal direction. A micro bone saw with a blade with a width of 10 mm is used. Safety is ensured by placing a stopper on the blade taking into account the thickness of the lamina, which is learnt from the preoperative CT scan.

This surgical method was used in all spinal cases requiring laminectomy from May 1995 till June 1998. After laminectomy was completed two surgeons using an intraoperative microscope examined the surgical field to determine the presence of any damage to the dura, spinal cord, nerve root and epidural vessels. As listed in Table 1, investigated parameters included patient age, sex, underlying disease, laminectomy level, number of laminae resected, operative time, intraoperative blood loss, and complications at the time of laminectomy.

Results

There were a total of 154 patients: 102 men and 52 women, with a mean age of 54 ± 16 years. The underlying disease was spinal cord tumor in 46 cases, lumbar canal stenosis in 43, lumbar disc hernia in 39, ossification of the spinal ligament in 6, Arnold-Chiari malformation in 5, spondylolisthesis in 4, and miscellaneous in 11.

The laminectomy level included all vertebrae from the atlas to sacrum, with a total of 348 laminae resected. The lumbar vertebrae were overwhelmingly represented: L4, 72 laminae; L5, 44 laminae; L3, 40 laminae. The operative time averaged 201 ± 117 min and mean blood loss was 352 ± 474 g.

Regarding complications at the time of laminectomy, there was no injury to the spinal cord or nerve root. The dura was lacerated for a length of 5–10 mm at 5 sites in 5 cases. The dural lacerations were only present in cases with previous spinal operations in which the dura bulged

Table 1 Investigations following laminectomy

No	Age (years)	Sex	Disease	Laminectomy level	Laminectomy number	Operation time (min)	Bleeding (ml)	Complications during surgery
1	63	M	Neurilemmoma	L2,3	2	165	208	–
2	43	M	Neurilemmoma	C4,5	2	655	2992	Vessel
3	55	F	Disc hernia	L3,4	2	135	229	–
4	70	M	LSCS	L4	1	245	1013	–
5	69	M	Lymphoma	T5–9	5	190	933	–
6	55	F	Neurilemmoma	C6,7 T1	3	185	300	Vessel
7	66	M	Syrinx	T8–11	4	225	320	–
8	46	M	Neurilemmoma	L3,4	2	145	200	–
9	74	F	LSCS	L5	1	145	243	–
10	33	M	Ependymoma (MP)	L2,3	2	225	73	Vessel
11	54	M	Neurilemmoma	L4,5	2	200	466	–
12	56	M	Neurilemmoma (re-op)	T11,12, L1	3	375	682	Vessel
13	1	M	Neurilemmoma	T4–6	3	150	200	–
14	18	M	Osteoblastoma	T7	1	120	250	–
15	50	F	Neurilemmoma	T12,L1	2	154	394	Vessel
16	57	F	IM hematoma	T7–9	3	425	2159	–
17	58	F	IM tumor (meta)	C7 T1	2	540	816	Vessel
18	47	M	OPLL	C6,7, T1–5	7	305	520	–
19	43	M	Spinal tumor (meta)	L2,3	2	275	1735	Vessel
20	20	M	Neurilemmoma	C4–7	4	435	890	Vessel
21	60	M	Spinal tumor (meta)	T4–6	3	210	1217	Vessel
22	45	F	Lipoma	T12 L1	2	285	590	dr
23	63	F	LSCS	L3,4	2	235	365	–
24	69	M	LSCS	L4	1	320	840	–
25	35	F	Neurilemmoma	T10,11	2	189	188	–
26	44	M	Syrinx	T11,12	2	170	120	–
27	55	M	Neurilemmoma	T5–7	3	200	187	–
28	47	M	Neurilemmoma	T8–10	3	230	695	–
29	15	M	Hemangioma (IM)	C3–7 T1–4	9	620	573	Vessel
30	66	M	LSCS	L4	1	220	180	–
31	33	M	Neurilemmoma	C1,2	2	350	450	Vessel
32	75	M	LSCS	L4,5	2	200	334	–
33	68	M	Meningioma	T11,12	2	160	529	–
34	23	F	Hemangioma	T12,L1	2	305	184	–
35	60	M	OLF	T9–11	3	300	630	–
36	57	F	Neurilemmoma	L3	1	165	51	–
37	69	F	LSCS	L4,5	2	160	292	–
38	38	F	Neurilemmoma	L4,5 S1,2	4	355	1318	Vessel
39	70	F	LSCS	L4	1	150	243	–
40	56	F	LSCS	L2–5	4	313	680	–
41	35	M	LSCS achon	L2–5	4	265	555	–
42	39	M	LSCS achon	L1–5	5	240	650	–
43	46	M	Disc hernia (re-op)	L4	1	125	124	dr
44	69	M	Neurilemmoma	T11,12	2	150	116	Vessel
45	45	m	Myelopathy	C3–7	5	160	240	–
46	24	f	Arnold-Chiari m	T3	1	260	375	–
47	40	F	Neurilemmoma	T12 L1,2	3	215	250	–
48	64	M	Malignant lymphoma	L4,5 S1,2	4	240	205	Vessel
49	55	M	Arnold-Chiari m	C3	1	265	45	dr
50	23	M	Lipoma	S1,2	2	185	12	–
51	78	F	Neurilemmoma	T3,4	2	145	160	–
52	40	F	Neurilemmoma	T4,5	2	150	177	–
53	48	F	Ependymoma	T1,2	2	365	325	–
54	32	M	Disc hernia	L5	1	175	57	–
55	8	M	Lipoma	L4,5 S1	3	175	67	Vessel
56	68	F	Dural cyst	T10–12 L1	4	225	127	dr
57	64	M	Disc hernia	L3,4	2	85	120	–
58	63	M	Disc hernia	L3,4	2	105	178	–
59	65	F	LSCS	L4	1	120	182	–
60	78	F	Meningioma	T8–10	3	165	165	–
61	37	F	Arnold-Chiari m	C7 T1	2	225	124	–
62	78	M	LSCS	L2–4	3	207	498	–
63	61	F	Disc hernia	L4	1	120	249	–
64	35	M	Neurilemmoma	T1,12 L1	3	260	244	Vessel
65	44	M	Meningioma	T2–4	3	360	450	–
66	68	M	Disc hernia	L5, S1	2	342	190	–
67	80	F	Spondylolisthesis	L4	1	210	202	–

Table 1 (continued)

No	Age (years)	Sex	Disease	Laminectomy level	Laminectomy number	Operation time (min)	Bleeding (ml)	Complications during surgery
68	56	M	Disc hernia	L1, 3,4	3	235	262	—
69	40	M	OPLL, OLF	T11,12	2	610	3607	—
70	48	M	Disc hernia	L4	1	115	101	—
71	47	M	Disc hernia	L3	1	80	46	—
72	54	F	Meningioma	T10,11	2	135	120	—
73	44	M	Disc hernia	C3–7	5	145	232	—
74	57	M	LSCS	L3,4	2	165	555	—
75	80	F	Spondylitis	T3–5	3	95	541	Vessel
76	47	F	Disc hernia	L4	1	130	165	—
77	38	F	Arnold Chiari m	T2,3	2	240	184	—
78	72	M	LSCS	L3–5	3	110	48	—
79	39	F	IM spinal tumor	C1–3	3	480	100	—
80	61	M	LSCS	L3	1	175	494	—
81	55	F	OPLL	T3–11	9	330	1307	—
82	27	M	Cyst	C1–3	3	235	203	—
83	66	F	LSCS	L4,5	2	95	83	—
84	73	F	Meningioma	T8,9	2	170	231	—
85	47	F	OLF	T11,12	2	55	12	—
86	72	M	LSCS	L3–5	3	160	395	—
87	41	M	OPLL, OLF	T8–10	3	140	432	—
88	65	M	LSCS	L4,5	2	100	25	—
89	50	M	LSCS	L4	1	100	75	—
90	53	M	Ependymoma (MP)	L2,3	2	250	318	—
91	70	M	LSCS	L3,4	2	145	263	—
92	49	M	Disc hernia	L3	1	65	38	—
93	65	M	Neurilemmoma	L3	1	155	172	—
94	49	M	Disc hernia	C3–7	5	170	537	—
95	56	M	Disc hernia	C3–7	5	200	181	—
96	73	M	LSCS	L4	1	140	156	—
97	37	M	Disc hernia	L5	1	150	274	—
98	37	M	Disc hernia	L2–5	4	170	110	—
99	54	M	LSCS	L4	1	132	57	—
100	76	M	Burst fracture	T11,12	2	377	1174	—
101	64	M	Spinal tumor	C7	1	125	106	—
102	77	M	LSCS	L4	1	115	127	—
103	41	F	Arnold-Chiari m	T4	1	250	277	—
104	70	F	LSCS	L5	1	85	85	—
105	71	F	Disc hernia	L4	1	70	109	—
106	80	F	LSCS	L5	1	90	140	—
107	64	F	LSCS	L3–5	3	215	709	—
108	46	F	LSCS	L4	1	90	129	—
109	49	F	Spondylolisthesis	L4	1	250	358	—
110	61	M	Disc hernia	L5	1	120	114	—
111	67	F	LSCS	L4,5	2	115	145	—
112	72	M	LSCS	L5	1	130	372	—
113	45	M	LSCS	L3–5	3	160	373	—
114	21	M	Disc hernia	L5	1	100	79	—
115	69	M	LSCS	L4,5	2	100	8	—
116	25	M	Disc hernia	L5	1	85	94	—
117	37	M	Spondylolisthesis	L4	1	255	587	—
118	73	F	LSCS	L3–5	3	113	87	—
119	79	M	LSCS	L3,4	2	115	191	—
120	54	M	Disc hernia	L5	1	50	79	—
121	74	F	LSCS	L4,5	2	120	86	dr
122	74	F	LSCS	L3–5	3	185	256	—
123	54	M	Disc hernia	L5	1	60	57	—
124	24	M	Disc hernia	L5	1	60	57	—
125	50	M	Ependymoma	T8–10	4	595	161	—
126	21	M	Ependymoma (MP)	T11,12 L1–3	5	660	945	Vessel
127	65	M	LSCS	L2–4	3	150	130	—
128	69	M	Disc hernia	L4	1	95	131	—
129	73	M	LSCS	L3,4	2	140	70	—
130	72	M	Disc hernia	L4,5	2	185	94	—
131	44	M	Disc hernia	L2–4	3	250	336	—
132	61	F	Disc hernia	L2	1	85	70	—
133	63	M	LSCS	L4-5	2	175	80	—
134	40	F	Neurilemmoma	L1,2	2	155	262	—

Table 1 (continued)

No	Age (years)	Sex	Disease	Laminectomy level	Laminectomy number	Operation time (min)	Bleeding (ml)	Complications during surgery
135	63	M	Disc hernia	L4	1	125	71	—
136	60	M	Spondylolisthesis	L4	1	130	25	—
137	67	M	Disc hernia	L2–4	3	190	188	—
138	71	F	Burst fracture	L3,4	2	295	793	—
139	59	M	LSCS	L4	1	115	45	—
140	64	F	Disc hernia	L5	1	100	25	—
141	67	F	Burst fracture	T11,12	2	355	349	—
142	33	M	Disc hernia	L4	1	170	46	—
143	77	M	Disc hernia	L3,4	2	170	261	—
144	77	M	Disc hernia	L2–4	3	135	180	—
145	68	M	Disc hernia	L4	1	105	89	—
146	61	M	Disc hernia	L4	1	120	96	—
147	56	M	Neurilemmoma	T9–11	3	109	451	—
148	66	M	Disc hernia	L3–5	3	240	557	—
149	51	M	Disc hernia	L4,5	2	130	140	—
150	52	M	Disc hernia	L4,5	2	155	188	—
151	59	F	Neurilemmoma	L4,5	2	220	135	—
152	66	M	LSCS	L4,5	2	185	75	—
153	77	M	LSCS	L3–5	3	255	655	—
154	56	M	LSCS	L4	1	125	152	—

Mp, myxopapillary; IM, intramedullary; Achon, Achondroplasia; OPLL, ossification of posterior longitudinal ligament; OLF, ossification of ligamentum flavum; LSCS, lumbar spinal canal stenosis; dr, dural laceration; vessel, cut epidural vessels and bleeding

out markedly, and adhesions were present between the dura and lamina, suturing was easy to perform. In 18 cases epidural vessels were severed, but in all cases the bleeding was readily controlled. There was no nerve damage observed.

Discussion

In operations such as resection of spinal tumors in which extensive manipulations within the spinal canal are required, a major concern is the achievement of laminectomy at the least risk. In the lumbar spine osteoplastic laminectomy using a chisel [1,3] is a good method which, however, is only being applied by a limited number of surgeons. Recently, the thread saw has been developed [4]. This is a safe method because the laminae are resected from the medial toward the lateral side of the spinal canal. En block laminectomy is also feasible, and the laminae are easily returned to their original position. However, passage of a thin thread saw through the spinal canal in the presence of tumor or herniated disc is difficult and requires particular technical skill and much time.

Based on experiments we assumed that the use of a micro bone saw to sever the laminae would be associated with little risk of nerve injury. Prior to applying the technique in clinical cases we performed total laminectomy (C1–L5) using a micro sagittal saw (Zimmer) in cadavers prepared for student teaching. We were able to complete right-left total laminectomy (48 laminae) within 60 min. Observation with a magnifying glass revealed that when the medial side of the facet joint was cut the root fixed in formalin was also intact. Considering that it would be important to know the thickness of the lamina at the re-

section site at the time of amputation, five sets of bleached bones were borrowed from the department of anatomy, and the thickness of each lamina was measured. It is vital to keep in mind the mean value of the thickness of the lamina at each level when undertaking laminectomy.

Based on the above research we performed laminectomy with the same technique in actual clinical cases. As explained complications were limited to 5 dural lacerations each measuring less than 10 mm. Absolutely no spinal cord or nerve root injury was evident. However, in cases of spinal cord tumor or inflammation, the epidural vessels are well developed and swollen, and were cut in 18 of our patients. The bleeding was however easily controllable by covering the site with cotton or other hemostatic material.

The described en bloc laminectomy performed using a micro bone saw makes it possible to completely restore the resected laminae to their anatomical position [2], and was associated with only little scar tissue formation. It is also useful in preventing spinal deformity.

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