Journal of Clinical Neuroscience 16 (2009) 650–654

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

Clinicopathological considerations in patients with lumbosacral extraforaminal stenosis

Joonsuk Song *, Jang-Bo Lee, Jung-Keun Suh

Department of Neurosurgery, Anam Hospital, Korea Medical University, 126-1, Anam-Dong, Seongbuk-Ku, Seoul 136-705, Korea

ARTICLE INFO

Article history:
Received 15 February 2007
Accepted 3 June 2008

Keywords:
Spinal stenosis
Extraforaminal stenosis
MRI

ABSTRACT

Lumbosacral extraforaminal stenosis is not uncommon among patients being treated for radicular symptoms. Patients who had lumbosacral extraforaminal stenosis were reviewed, and cadaver dissection was used to determine the anatomy of extraforaminal lesions. A total of 167 patients with lumbosacral spinal stenosis who underwent surgery from March 2004 to February 2006 were reviewed retrospectively. Among these, extraforaminal stenosis was observed in 26 patients (mean age 61.4 y; range 46–79). Leg pain and neurogenic claudication were common in patients with extraforaminal stenosis. One level was involved for 15 patients and 2 levels were involved for 11 patients. Complete decompression of the dorsal root ganglion or a root compressed by the fibrocartilagenous ligamentum flavum or a hypertrophied superior facet was performed. The mean follow-up was 8.3 months (range 6–26 months). The causes of extraforaminal stenosis were superior facet hypertrophy, especially hypertrophy of the superior lateral portion, or thickening of the ligamentum flavum, intertransverse ligament, or transforaminal ligament. T1-weighted, coronal MRI showed root impingement in the far-lateral zone. Postoperative outcomes were assessed using the Prolo scale; 13 patients demonstrated excellent outcomes, while 11 patients had good outcomes. No major complications or recurrences were observed during follow-up. Therefore, lumbosacral extraforaminal stenosis should be included in the differential diagnosis of lumbar radicular pain. A precise diagnosis using MRI is important, and complete decompression with an understanding of the extraforaminal anatomy is required.

1. Introduction

Extraforaminal (EF) stenosis was first demonstrated by Wiltse et al. in 1984, who reported that a nerve can be compressed between the transverse process and the ala of the sacrum in cases of surgical decompression failure and emphasized the importance of complete decompression far laterally and fusion.[1] For patients who complain of severe leg pain and neurogenic claudication, especially for those with failed back surgery syndrome (FBSS), incomplete decompression at the EF space may cause persistent leg pain after surgery. EF stenosis by far-lateral disc herniation has also been reported, and there are many surgical approaches addressing this issue.[2–7]

Reports of EF stenosis due to facet or ligament hypertrophy are, however, rare. We reviewed 26 patients with EF stenosis and studied the structures in the EF space by cadaver dissection.

2. Material and methods

2.1. Patient population

We reviewed retrospectively 167 patients with spinal stenosis who underwent surgery between March 2004 and February 2006. Of these, EF stenosis was observed in 26 patients, as confirmed during surgery. There were 8 men and 18 women with EF stenosis from 46 to 79 years old (mean age, 61.4 y). One level was involved in 15 patients (L5/S1 in 8, L4/5 in 6, and L3/L4 in 1) and two levels in 11 patients (L4/5, L5/S1 in 8; L3/4, L4/5 in 3 patients). The 26 patients with EF stenosis experienced symptoms that included severe leg pain due to the compression of a root or dorsal root ganglion, neurogenic claudication, hamstring tightness, and back pain. Mild far-lateral disc herniation was present in 8 patients, and FBSS was observed in 7 patients. We excluded patients with isolated far-lateral disc herniation from this study. Clinical data are summarized in Table 1.

2.2. Radiological examination

We examined all patients with spinal stenosis using plain radiographs and MRI. Flexion and extension radiographs were also

* Corresponding author. Tel.: +82 2 920 5729; fax: +82 2 929 0629.
E-mail address: jssong0929@yahoo.co.kr (J. Song).

0967-5868/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jocn.2008.06.003

Table 1
Clinical data for 26 patients with extraforaminal stenosis

Patient	Age/Sex	Symptoms	Involved level	The causes of EF stenosis	FBSS	Treatment	Complication	Outcome
1	79/M	NC, BP	L4/5, L5/S1	SFH, LFH	L4/5	Adhesiolysis, ST4, T5, IBF, SF	CSF leak	Fair
2	67/F	LP, NC, BP	L5/S1	SFH, LFH, LH	L5/S1	Adhesiolysis, IBF, SF		Good
3	70/F	NC	L4/5	SFH, LFH		T4, IBF, SF		Excellent
4	62/F	NC, BP, LP	L4/5, L5/S1	SFH, LHH, LH		ST4, T5, IBF, SF		Excellent
5	71/F	LP, NC	L5/S1	SFH, LFH, FLDH		Combined approach		Good
6	64/M	NC, LP	L5/S1	SFH, LFH, LH	L4/5	Adhesiolysis, T5, IBF, SF		Good
7	46/M	NC, HT	L3/4	SFH, LFH	L4/5	Adhesiolysis, T3, IBF, SF		Good
8	57/F	LP, NC	L5/S1	SFH, LFH		ST5, IBF, SF		Excellent
9	64/F	NC, LP, BP	L3/4, L4/5	SFH, LFH, LH		ST3, T4, IBF, SF		Good
10	57/F	NC, BP, HT	L4/5	SFH, LFH, FLDH		ST4, IBF, SF		Excellent
11	74/F	NC, BP	L5/S1	SFH, LFH		ST5, IBF, SF		Excellent
12	74/M	LP, NC	L4/5, L5/S1	SFH, LFH, FLDH		ST4, T5, IBF, SF	Hematoma	Fair
13	60/F	NC, LP	L4/5, L5/S1	SFH, LFH, FLDH		ST4, T5, IBF, SF		Excellent
14	54/M	LP, NC	L5/S1	SFH, LHH, LH		ST5, IBF, SF		Excellent
15	66/F	LP, NC	L5/S1	SFH, LFH, FLDH		T5, IBF, SF		Good
16	51/F	NC, BP, LP	L3/4, 4/5	SFH, LFH		T4, IBF, SF		Excellent
17	67/M	NC, HT	L3/4, L4/5	SFH, LFH		ST3, T4, IBF, SF		Excellent
18	68/F	BP, LP, NC	L4/5, L5/S1	SFH, LFH, LH		ST4, T5, IBF, SF	Hematoma	Good
19	72/M	BP, NC, LP	L4/5, L5/S1	SFH, LFH		T4, ST5, IBF, SF	CSF leak	Good
20	61/F	NC, BP	L4/5, L5/S1	SFH, LFH	L4/5	Adhesiolysys, ST3, T4, IBF, SF		Good
21	75/F	NC	L4/5	SFH, LFH		T4,5, IBF, SF		Excellent
22	58/F	LP, BP	L5/S1	SFH, LFH, FLDH	L5/S1	Adhesiolysis, T5, IBF, SF		Good
23	57/F	LP, NC	L4/5	SFH, LFH, FLDH		T4, IBF, SF		Excellent
24	61/F	NC, LP, BP	L4/5, L5/S1	SFH, LFH, LH		T4,5, IBF, SF		Excellent
25	53/F	NC, HT	L4/5	SFH, LFH, FLDH	L5/S1	T4, Adhesiolysis		Good
26	54/M	NC, LP	L4/5	SFH, LFH, LH		T4, IBF, SF		Excellent

BP = back pain, Combined approach = midline and far-lateral approach, CSF = cerebrospinal fluid, F = female, FLDH = far lateral disc herniation, HT = hamstring tightness, IBF = interbody fixation, LFH = ligamentum flavum hypertrophy, LH = ligament hypertrophy such as hypertrophy of the transforaminal ligament or intertransverse ligament, LP = leg pain, M = male, NC = neurogenic claudication, SF = screw fixation, SFH = superior facet hypertrophy, ST = subtotal laminectomy, T = total laminectomy.

obtained to assess spinal stability. We took coronal MRI in 5 patients who complained of severe leg pain and in whom no definite root compression was found in axial or sagittal MRI. CT myelography was also performed in patients with FBSS. In addition, we evaluated isotope bone scans and bone densitometry findings.

2.3. Surgical procedure

We performed a total facetectomy in the 26 patients with EF stenosis. After total laminectomy, we removed the inferior facet using a high-speed drill or osteotome and rongeur and decompression was extended to the pars interarticularis. The superior and lateral portion of the superior facet and hypertrophied ligamentum flavum (LF) were then removed using a drill and a Kerrison punch. The affected nerve root (the L4 nerve root for L4/L5 EF stenosis) compressed by a hypertrophied superior facet or a fibrocartilagenous LF was relieved after decompression. Then, advancing to the lateral area, we removed the hypertrophied ligaments or scar tissue. After a discectomy, we performed fusion with an interbody cage and pedicle screw fixation. All patients started ambulating the day after surgery and were discharged 1 week after surgery.

3. Results

3.1. Causes of extraforaminal stenosis

Superior facet hypertrophy, especially hypertrophy of the superior lateral portion, and LF hypertrophy were the most common causes of EF stenosis and were observed in all patients (Fig. 1). In 8 patients with combined far-lateral disc herniation, the affected nerve root was severely compressed by the herniated disc anteriorly and by the hypertrophied superior facet and LF posteriorly. Ligamentous hypertrophy involving the transforaminal ligament or intertransverse ligament was found in 8 patients who complained of severe leg pain without definite foraminal stenosis on preoperative radiological studies. In 3 of the 8 patients with FBSS, we observed a fibrocartilagenous change of the LF.

3.2. Surgical outcome

The mean follow-up was 8.3 months (range 6–26 months). Postoperative states were evaluated using the Prolo scale. Thirteen patients achieved excellent results, while 11 achieved good results and 2 had fair results. Postoperatively, pain was relieved immediately, and there were no major complications. A dural tear occured in 2 patients, and hematomas in 2 patients. No recurrences were observed.

3.3. Surgical complications

There was cerebrospinal fluid leakage in 2 patients and hematomas in 2 patients. In patients with FBSS, severe adhesions can be found in the extraforaminal space due to hypertrophied scar formation. In one patient with a dural tear during surgery, we placed lyodura and fascia with fibrin glue over the dura after meticulous suturing of the defect. Spinal drains were not used. Two patients who complained of back and leg pain after surgery and in whom hematomas were seen on postoperative MRI underwent re-operation to remove the hematoma.

4. Discussion

4.1. Anatomy of the extraforaminal space

The microsurgical anatomy of the far-lateral space has been described.[8,9] The far-lateral compartment is anatomically defined as the area lateral to the superior and inferior pedicles and is bounded by the disc anteriorly, the superior articular facet medially, and the facet joint posteriorly. The transforaminal ligament is a narrow band of collagen fibers that traverses the outer end of the intervertebral foramen, and the intertransverse ligament is composed of