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Clinical Outcome of Posterolateral Endoscopic Surgery for Pyogenic Spondylodiscitis

Results of 15 Patients With Serious Comorbid Conditions

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Study Design. Clinical results of posterolateral endoscopic debridement and irrigation followed by percutaneous drainage for pyogenic spondylodiscitis were analyzed.

Objectives. To report clinical results of transforaminal endoscopic surgery for pyogenic spondylodiscitis and to evaluate the effectiveness of this procedure in treatment of pyogenic spinal infections.

Summary of Background Data. Pyogenic spinal infections have been increasing due to the development of medical treatment for patients with comorbid medical problems. Common treatments for spinal infections are administration of antibiotics or surgical debridement with bone grafts. There have been no reports, however, regarding the clinical outcome of posterolateral endoscopic treatment for pyogenic spinal infections.

Methods. Fifteen consecutive patients with pyogenic spondylodiscitis in the thoracic or lumbar spine were enrolled. Preoperative antibiotic treatment had failed in all the patients. The procedures consisted of posterolateral endoscopic debridement and irrigation followed by percutaneous drainage through single portal under the combination of local and intravenous anesthesia. Pain response using visual analog scale (VAS, 0–100 mm), inflammation parameters, and duration of antibiotic therapy were investigated. Radiologic evaluation focused on bony fusion, local kyphosis, disc height reduction, and abscess formation.

Results. All patients showed immediate pain reduction after surgery. Averaged VAS for pain was 86 before surgery and 25 at postoperative 1 week. Average of CRP was 4.00 mg/dL before surgery and 1.88 mg/dL at postoperative 1 week. Averaged duration of antibiotics therapy was 3.7 weeks. Spinal fusion was obtained in 13 patients. Two patients with neurologic deficits due to epidural abscess returned to normal. Preoperative psoas abscess in 6 patients disappeared after surgery on MRI.

Conclusions. Posterolateral spinal endoscopic debridement and irrigation brought immediate pain reduction and good clinical results to patients who had comorbid medical problems and had pyogenic spondylodiscitis.

Key words: pyogenic spondylitis, pyogenic discitis, posterolateral spinal endoscopic surgery, minimally invasive spinal surgery. **Spine 2007;32:200–206**

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The number of pyogenic spinal infections has been increasing in the past few decades.[1] The main reason for the increase is probably due to an increase of immunosuppressed patients who have comorbid medical problems, such as diabetes mellitus, HIV infection, collagen diseases, neoplasmic diseases, intravenous drug users, or others. Also, the number of iatrogenic spinal infections after spinal injections or surgeries has been increasing. As contemporary medical treatment for aforementioned serious systematic diseases prolongs the life of the patients, the opportunities for these patients to suffer from spinal infections are getting more frequent.

Although the advent of MRI can make early diagnosis of spinal infections and physicians can start antibiotics therapy in the early phase of infection,[2] some patients with pyogenic spinal infections are resistant to initial antibiotic treatment because of their immunosuppressed or poor general conditions. For the patients who are immunosuppressed or have multiple comorbidities, major spinal surgery consisting of anterior debridement and bone grafts with or without spinal instrumentation often relates to postsurgical complications, including relapse of infection, wound dehiscence, pseudarthrosis, and instrumentation failures.[3] As a minimally invasive treatment, CT-guided biopsy and suction tube placement or percutaneous discectomy have been reported effective in selected patients whose destructive changes of the infected vertebrae are minimal.[4–7] Moreover, limitation of CT-guided biopsy in detecting the organisms often leads surgeons to performing more invasive spinal surgeries.[8]

In 1983, Kambin and Gellman introduced the posterolateral extracanal approach in the treatment of lumbar disc herniation.[9] Yeung and Tsou improved visualization and operative access using Holmium-YAG laser and a radiofrequency trigger-flex bipolar coagulator probe.[10] By the development of optical equipment, more aggressive debridement of disc materials became possible, and most lumbar disc herniations can be treated with this posterolateral approach. So far, this technique has only been described in the literature in the treatment of lumbar disc herniations or lumbar discogenic pain.[11] Therefore, there have been no reports regarding the effectiveness of this posterolateral spinal endoscopic surgery for pyogenic spondylodiscitis. The purposes of this study are to report the clinical results of posterolateral spinal endoscopic surgery for pyogenic spondylodiscitis in patients with multiple comorbidities.

Table 1. Patient Summary 1

Patient No.	Age (yr)	Gender	Level	Associated Medical Illness	ASA	Diagnosis to Surgery (wk)
1	66	F	L4–L5	Multiply operated back, diabetic	3	40
2	73	M	L3–L4	Gastric cancer	2	4
3	68	M	L3–L4	None	1	5
4	46	M	T9–T10	Dissociating aortic aneurism, long stay at ICU	2	6
5	73	F	L4–L5	RA, long-term steroid therapy	3	24
6	64	F	L3–L4	MRSA sepsis	3	6
7	15	M	L3–L4	None	1	5
8	54	M	L3–L4	CRF, non-Hodgkin lymphoma	2	103
9	64	M	L4–L5	Non-Hodgkin lymphoma	2	3
10	29	M	L3–L4	Crohn's disease, MRSA sepsis	2	8
11	68	M	L5–S	Dermatomyositis, diabetic, prostate cancer	3	14
12	73	M	L2–L3	Salmonella sepsis, cardiac failure, Parkinson disease	3	10
13	65	F	L1–L2	MRSA sepsis, liver cirrhosis, Osler disease, Sjögren disease	3	15
14	68	M	L5–S	Laryngeal cancer, hemiparesis	2	8
15	65	F	L5–S	Diabetic nephropathy, hypertension, lung cancer	3	22
Average	59					20.4

ICU indicates intensive care unit; RA, rheumatoid arthritis; CRF, chronic renal failure; ASA, graded scale by the American Society of Anesthesiologists.

■ Materials and Methods

Demographic Data of the Patients. Fifteen consecutive patients have been treated with posterolateral transforaminal spinal endoscopic surgery for pyogenic spondylodiscitis. There were 10 males and 5 females. Their ages ranged from 15 to 74 years with an average of 60 years. The levels of infection were T9–T10 in 1 patient, L1–L2 in 2, L2–L3 in 1, L3–L4 in 6, L4–L5 in 2, and L5–S in 3. Detailed information of the patients is listed in Table 1. Most patients had serious comorbid medical problems, such as rheumatoid arthritis, cardiac problems, chronic renal failure, cancer, or lymphoma. By the grading system of the American Society of Anesthesiologists, the general condition of the patients was graded as III in 7, II in 6, and I in 2. Previous physicians had treated all the patients with antibiotics and bed rest. Despite previous conservative treatment, their spinal infection had not subsided and they were referred to our institution. The interval between the first diagnosis of spinal infection and surgery at our institution ranged from 3 weeks to 104 weeks with an average of 20 weeks. The organisms had been identified only in 6 patients by blood cultures or needle biopsy done by the previous physicians.

Surgical Procedures. Administration of antibiotics ceased at 7 days before the posterolateral spinal endoscopic surgery. The carbon bed and fluoroscopic guidance were used. A patient was positioned prone on a U-shaped frame in order to decrease abdominal pressure and lumbar lordosis. Skin markings were drawn to represent calculations of optimal needle entry. In order to work on the entire disc space, a guide needle should be inserted 45° obliquely to the vertical line targeting the center of the disc space. Yeung Endoscopic Spinal System (Richard Wolf Co., IL) and Surgitron IEC-3 (Ellman Japan, Osaka, Japan) were used for posterolateral spinal endoscopic equipment. Local anesthesia using 1% lidocaine combined with intravenous anesthesia was used for anesthesia. The patients should be awake during the procedure so that they can respond when the nerve roots were irritated during the procedures. An anesthesiologist added an appropriate dose of fentanyl or benzodiazepine intravenously when the patient felt considerable pain during procedures. The most painful procedure was the penetration of the anulus at the infected discs by a trephine. The posterolateral spinal endoscopic procedures were the same as Yeung and Tsou[10,11] had described. The single portal approach was used in this series of patients. A tubular working cannula was placed mostly on the left side of the patient because of the surgeon's preference. When the disc height or neural foramen was severely narrowed on the left side, the working cannula was placed on the right. Aggressive debridement of both infected disc material and vertebral bodies was conducted using several types of rongeurs and automated burrs. Flexible rongeurs helped to remove both cranial and caudal infected vertebral bodies (Figure 1). The tip of the instruments was monitored under fluoroscopic guidance. Debridement should be carried out until the intact upper and lower vertebral bodies could be seen (Figure 2). When the fibers of anulus interfered with the scopic view, Surgitron IEC-3 (Ellman Japan) helped to shrink the disc materials and clear the vision. If the abscess formation on both sides of the psoas muscles and severe destructive changes in the spinal column were evident, bioportal access could be used for more aggressive debridement of infected materials. Cultures of the organisms were taken in the resected materials to identify the organisms and effective antibiotics. After aggressive debridement of the infected discs and vertebral bodies, a cavity was created and the surgeons could observe upper and lower vertebral endplates at the site of infected disc spaces. And then, pressurized irrigation with more than 2 L saline was carried out. If sensitive antibiotics to the organisms had been already known by previous blood cultures or needle biopsy, 1 L of antibiotic solution was added for irrigation. When biportal access was used, one side of the portal could be used for the inflow of irrigation and the other side for the outflow. Bone grafting was not conducted for any patients. A drain tube of 3 mm diameter was placed in the infected area at the end of the procedure. The drainage continued for 3 to 10 days after surgery. The drain tube was a simple suction tube without continuous irrigation. Posterior decompression surgery, such as laminectomy, was not conducted, even in patients who had had preoperative epidural abscess causing neurologic deficits (Figure 3). The patients were allowed to walk at postoperative 1 day with a rigid thoracolumbar spinal orthosis (TLSO). The periods of wearing TLSO ranged from 3 weeks to 6 months with an average of 2 months.

Clinical Evaluation. Preoperative and postoperative pain response was evaluated by visual analog scale (VAS, 0–100 mm).[12] The organisms detected by this endoscopic procedure,

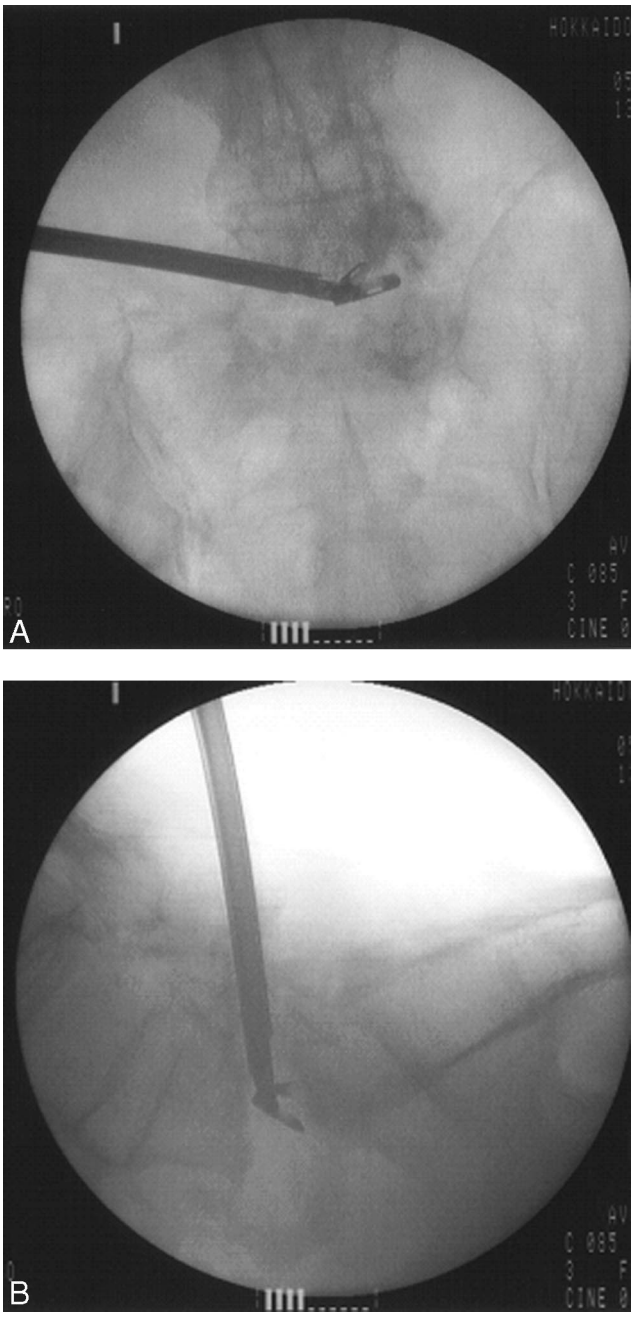

Figure 1. Fluoroscopic images during debridement of infected disc and vertebral bodies: **A**, anteroposterior view; **B**, lateral view. Several types of rongeurs, burrs, and radiofrequency enabled to achieve extensive resection of infected tissues. After aggressive debridement, a cavity was created at the site of the infected disc level and then pressurized irrigation with more than 2 L of saline or antibiotics solution should be performed. Simple suction tube was placed at the end.

changes of C-reactive protein (CRP), white blood cell count, erythrocyte sedimentation rate, changes of neurologic status, and duration of antibiotic therapy were investigated. Cessation of antibiotics treatment was done after confirming at least 2 times with an interval of several days that CRP dropped down to the normal level or the level before the onset of spinal infection. Radiographic evaluation was conducted to examine spinal fusion, local kyphosis, presence of epidural or psoas abscess, segmental instability, and fusion at the infected area.

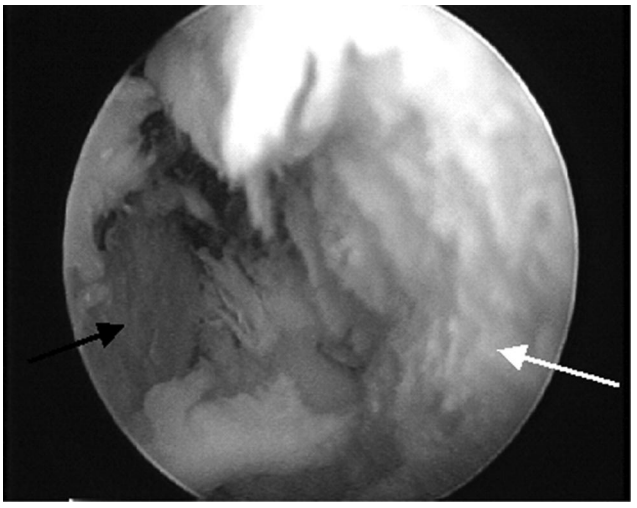

Figure 2. An endoscopic view from the inside of infected disc level (L4–L5). At the beginning of the procedure, the endoscopic view was not clear due to pus formation and granulation tissues at the infected disc level. By aggressive debridement, the endoscopic view became clear and the vertebral endplates above and below the infected disc space could be clearly seen (black arrow: upper endplate of the infected disc level; white arrow: lower endplate of the infected disc level).

Paired *t* tests were used to compare parameters at each stage before and after surgery.

■ Results

Postoperative follow-up periods ranged from 9 months to 40 months with an average of 25 months. One patient (Patient 9) died at postoperative 9 months due to the relapse of non-Hodgkin lymphoma. Another patient (Patient 15) died at postoperative 15 months due to lung cancer. There was no patient who had relapse of spinal infection at the treated level during follow-up. The comorbid medical problem (Crohn's disease) worsened in 1 patient (Patient 10) at postoperative 6 months. Left shoulder joint infection occurred in 1 patient (Patient 13) at postoperative 10 months, which was treated with arthroscopic irrigation followed by continuous irrigation.

Average operation time was 58 minutes. Intraoperative blood loss was minimal and uncountable. The organism was identified by this procedure in 11 patients (Table 2). In 6 patients whose organism had been unknown before surgery, the organism was detected by the endoscopic procedure. Averaged VAS for low back pain before surgery was 86 (Table 3) and 25 at postoperative 1 week. There was a statistically significant difference between preoperative and postoperative 1 week with regard to VAS ($P < 0.001$). Averaged VAS at postoperative 2 and 3 weeks was 14 and 7, respectively. Averaged VAS at 6 weeks after surgery was 5 (Table 3). Thereafter, low back pain had not worsened until the final follow-up.

Averaged CRP was 4.00 mg/dL (Table 3) before surgery and 1.88 mg/dL at postoperative 1 week. There was a statistically significant difference between preoperative and postoperative 1 week with regard to CRP ($P < 0.05$). By postoperative 6 weeks, CRP of 12 patients dropped down

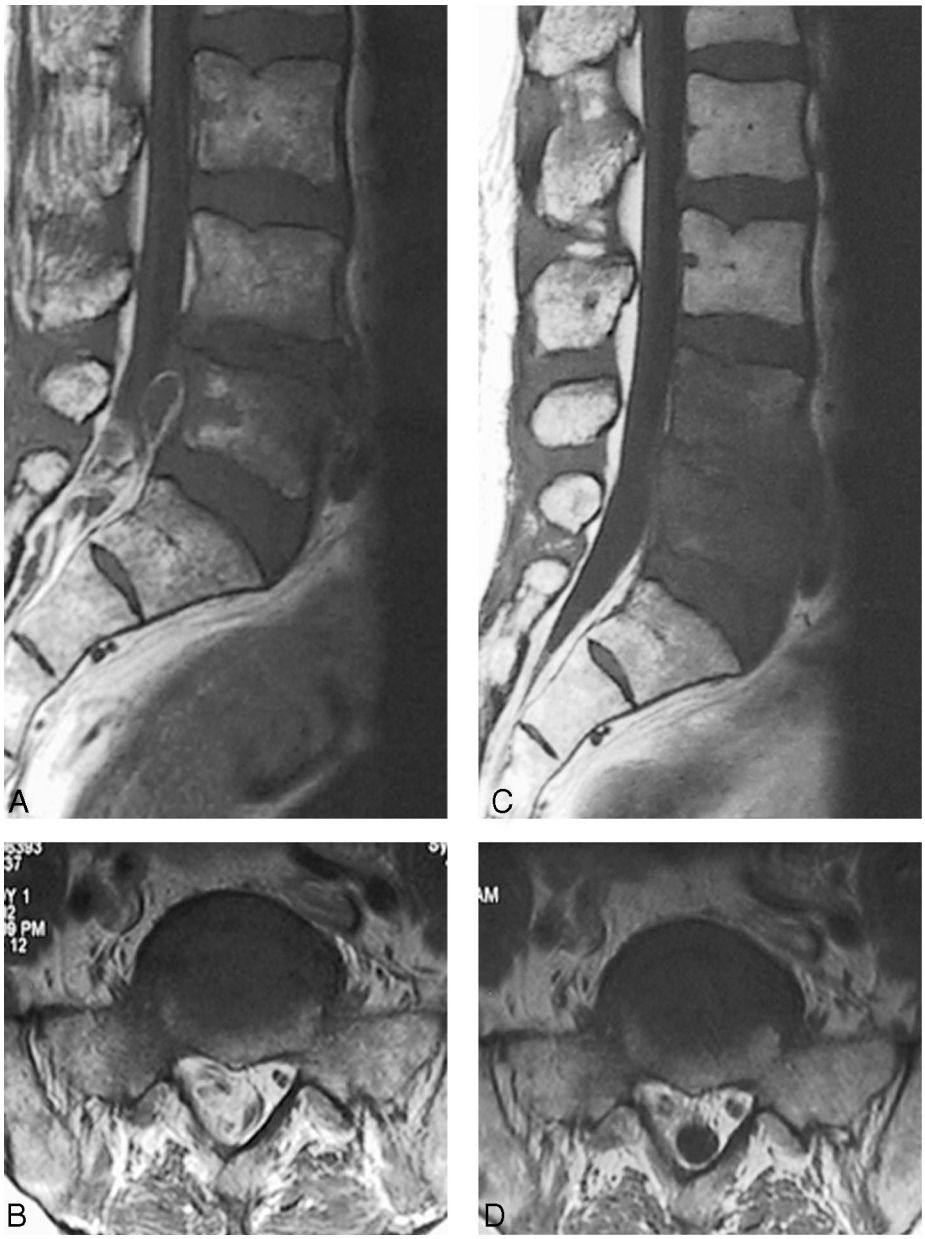

Figure 3. Sixty-four-year-old man (Patient 9) showed severe low back pain and right leg pain. His associated medical illness was non-Hodgkin lymphoma treated with intensive chemotherapy. Irrespective of antibiotic treatment, right L5 and S1 root deficits became clear due to large epidural abscess and spondylodiscitis at L4–L5 (**A**, **B**). Single portal was placed from the left side at L4–L5. Debridement of infected disc materials at L4–L5 disc and the tip of the suction tube were placed at the disc space. Laminectomy was not performed. His leg pain and low back pain decreased immediately after surgery, and MR images showed that epidural abscess disappeared at postoperative 4 weeks (**C**, **D**).

to the normal range. At postoperative 6 weeks, CRP of the other 3 patients (Patients 4, 9, and 11) remained higher than the normal range but reached the level before the onset of spinal infection (Table 3). Between postoperative 6 weeks and the final follow-up, there were 11 patients who showed elevation of CRP that related to their comorbid medical problems or infections of other organs. Averaged erythrocyte sedimentation rate (mm/hour) was 63 mm before surgery, 43 mm at postoperative 1 week, and 31 mm at postoperative 3 weeks. Averaged white cell counts were 7236/mm^3 before surgery, 6670/mm^3 at postoperative 1 week, and 5160/mm^3 at postoperative 3 weeks.

The organism causing spondylodiscitis was successfully detected in 11 patients by the samples taken during endoscopic procedures. In 6 patients out of the 11, the organism had been unknown before surgery. Cessation of antibiotics treatments was done by postoperative 2 weeks in 2 patients, 3 weeks in 7, 4 weeks in 1, 5 weeks in 3, and 6 weeks in 2. Averaged duration of antibiotics administration was 3.7 weeks.

There were 2 patients with preoperative neurologic deficits due to epidural abscess (Frankel D) (Patients 9 and 10). Their neurologic function returned to normal after surgery. Another 3 patients had shown radiating leg pain due to foraminal stenosis before surgery. Although their radiating pain down to the leg worsened immediately after surgery, their pain gradually decreased during follow-up.

Radiologic evaluation showed preserved disc space and mobile intervertebral segment in 2 patients whose preoperative destructive changes were minimal, fusion without residual kyphotic deformity in 4, and fusion with kyphotic deformity in 9. Local kyphosis ranged from 2° to 25° with an average of 12°. Two patients

Table 2. Patient Summary 2

Patient No.	Preoperative Culture	Identified Organism	Operation Time (min)	Duration of Antibiotics	Follow-up (mo)
1	*Staphylococcus epidermidis*	*Bacillus cereus*	86	2 wk IV, 1 wk oral	40
2	*Staphylococcus aureus*		51	1 wk IV, 2 wk oral	31
3			47	1 wk IV, 1wk oral	32
4	MRSA	MRSA	65	2 wk IV, 1 wk oral	36
5	MRSA	MRSA	45	1 wk IV, 2 wk oral	22
6		*Escherichia coli*	51	3 wk IV, 2 wk oral	26
7			65	2 wk IV, 1 wk oral	19
8		Candida	56	1 wk IV, 2 wk oral	24
9		MRSA	43	3 wk IV, 3 wk oral	9
10	MRSA, Pseudomonas, *Staphylococcus aureus*	MRSA	73	1 wk IV, 2 wk oral	20
11		*Escherichia faecalis* (MRSE)	67	2 wk IV, 4 wk oral	21
12		MRSE	50	1 wk IV, 4 wk oral	25
13	MRSA	MRSA	55	10 days IV, 3 wk oral	24
14			41	9 days IV, 2 wk oral	24
15		MRSE	72	1 wk IV, 1wk oral	15
			57.8		25

MRSA indicates methicillin-sensitive *Staphylococcus aureus*; MRSE, methicillin-sensitive *Staphylococcus epidermidis*; IV, intravenous.

(Patients 9 and 10) who had epidural abscess associated with pyogenic spondylodiscitis showed disappearance of epidural abscess after the endoscopic surgery without laminectomy (Figure 3). Preoperative psoas abscess in 6 patients also disappeared after surgery.

■ Discussion

Most patients involved in this study had serious comorbid medical problems, including cancer, severe liver dysfunction, rheumatoid arthritis, lymphoma, or others. The previous medical physicians had treated all of them with intravenous antibiotic administration for at least 4 weeks. Despite these intensive treatments, spinal infections could not be solved and the patients were referred to our institution. Probably due to previous intensive antibiotics treatment, there were 4 patients whose organisms could not be identified from cultures in the tissue resected during endoscopic procedures. From their clinical presentations, such as severe back pain, laboratory findings, and results of MR images, these patients were considered pyogenic spinal infection and enrolled in this series.

Rezai *et al* reported that 25% of patients who were initially treated nonsurgically experienced medical therapy failure.[1] The majority of their patients were intravenous drug abusers. Since the number of immunosuppressed patients has been increasing due to the advancement of medical management, it is becoming more difficult to treat the patients with pyogenic spinal infections only with conservative measures. In patients with advanced bony destruction, severe degree of neurologic deficits, open surgical treatment has been reported to be superior to conservative treatment in terms of neurologic recovery or reduction of low back pain.[8,13]

There have been numerous reports regarding surgical treatments, such as decompression and reconstruction for pyogenic spine infections.[14–16] Favorable results

Table 3. Pain Level and CRP Before and After Surgery

	Visual Analog Scale (0–100 mm)					CRP (mg/dL)				
Patient No.	Preoperative	Postoperative Week 1	Postoperative Week 2	Postoperative Week 3	Postoperative Week 6	Preoperative	Postoperative Week 1	Postoperative Week 2	Postoperative Week 3	Postoperative Week 6
1	95	45	35	40	15	0.99	0.24	0.24	0.24	>0.24
2	86	20	10	10	10	3.7	0.5	0.4	0.24	>0.24
3	98	40	20	5	5	3.6	0.4	0.5	0.24	>0.24
4	90	30	10	0	0	5.5	0.4	0.4	0.8	0.6
5	100	20	15	5	5	1.4	0.8	0.7	0.24	>0.24
6	87	30	20	10	10	1.91	0.74	0.24	0.24	>0.24
7	88	15	10	0	10	3.8	1.5	0.88	0.24	>0.24
8	82	5	0	0	0	0.99	1.02	0.74	0.24	>0.24
9	88	23	10	5	5	8.9	8.73	3.25	1.88	1.14
10	90	28	5	0	0	2.4	2.2	1.86	0.24	>0.24
11	82	5	5	0	0	4.5	2.79	2.65	2.48	0.8
12	73	40	30	15	10	7.83	1.3	0.24	0.24	>0.24
13	100	18	12	5	5	6.82	3.32	0.5	0.24	>0.24
14	73	45	20	0	0	4.01	0.28	0.24	0.24	>0.24
15	62	10	10	5	5	3.64	3.99	1.45	0.24	>0.24
Average	86.3	24.9	14.1	6.7	5.3	4	1.88	0.85	0.54	—
SD	10.3	13	9.1	9.9	4.6	2.33	2.15	0.91	0.67	—
	Preoperative *vs.* Postoperative Week 1: $P < 0.001$ Postoperative Week 1 *vs.* Postoperative Week 2: $P < 0.01$					Preoperative *vs.* Postoperative Week 1: $P < 0.05$ Postoperative Week 1 *vs.* Postoperative Week 2: not significant				

have been reported with regard to anterior debridement and fusion using autografts in patients with major bone destruction or neurologic impairment.[14,15] Use of spinal instrumentation at the site of infection is still controversial.[16,17] The most articles describing the results of surgical treatment using instrumentation used posterior spinal implants at remote areas from the infected site.[16–18] Even though these clinical reports concluded that the results of spinal reconstruction surgery using spinal implants were satisfactory, there were significant complication rates. Carragee reported that complication rates after spinal instrumentation surgery in patients with pyogenic spinal infections were 47% out of their 17 patients.[3] The complications included instrumentation failure, wound dehiscence, cardiac arrest, or inability of weaning of ventilator. Carragee also reported in a different article that 3 of 42 patients who underwent spinal surgery died in the acute postoperative period due to hepatic encephalopathy, hepatorenal failure, intracranial infarction, or septic shock.[19] Since the patients with pyogenic spinal infections had serious comorbid conditions, the success rates of major spinal surgery in these patients are not promising.

There have been several attempts to treat pyogenic spinal infections using minimally invasive surgical techniques. Valls *et al* reported the technique of needle biopsy for vertebral infections in 1984.[4] Yu *et al* published the technique of percutaneous suction aspiration in 2 cases.[6] Jeanneret and Magerl introduced the use of percutaneous external fixation following percutaneous suction or irrigation.[18] Haaker *et al* reported satisfactory results of 16 patients of lumbar disc infections, treated with percutaneous lumbar discectomy.[5] Our method using posterolateral spinal endoscopy enabled both extensive debridement of infected sites and pressurized irrigation under clear visualization. Even though patients had serious medical problems, including cancers, leukemia, or multiple organ failures, this procedure can be safely performed under the combination of local and intravenous anesthesia (Figure 4). If patients had minimal destructive changes, such as only disc space narrowing, this procedure prevents further destructive changes and progression of kyphotic deformity without using bone grafts. However, many patients with preoperative destructive changes at vertebral bodies showed progression of local kyphosis during follow-up. The reasons for the progression of kyphotic deformity would be both preoperative destructive changes of the anterior spinal column and aggressive debridement. Epidural abscess originating from the anterior spinal column can be successfully treated with this procedure without performing open posterior decompression. Since such epidural abscess had a connection with the infected anterior column, abscess in the spinal canal could be successfully drained by treatment only for the anterior column that was the origin of spinal infection.

The best indication of this procedure should be minimal or moderate destructive changes of the vertebrae in the

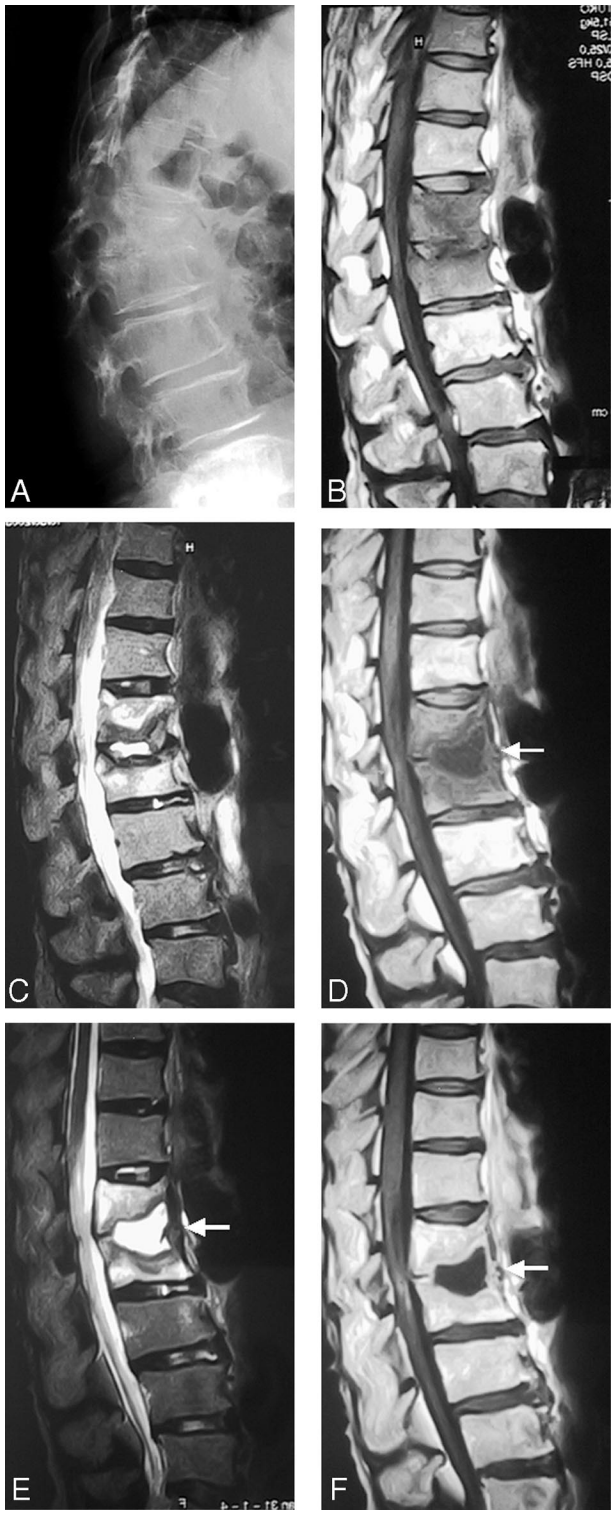

Figure 4. Sixty-year-old woman (Patient 13) had severe associated medical illness, including liver dysfunction, chronic heart failure, and several episodes of septic shock treated in ICU for more than 6 months. She had severe back pain and was unable to keep sitting position due to pyogenic spondylodiscitis at L1–L2. Preoperative images showed severe destructive changes at L1 and L2 vertebral bodies as well as L1–L2 intervertebral disc: **A**, lateral radiograph; **B**, T1-weighted; **C**, T2-weighted. Her back pain reduced after surgery and she became able to keep sitting or standing position with TLSO. At postoperative 4 months, her MR images showed a healing response around a large cavity created by debridement at L1–L2 (arrows): **D**, T1-weighted; **E**, T2-weighted; **F**, gadolinium enhancement.

early phase of pyogenic infections, which can be detected by both clinical signs and MR images. However, the effectiveness of this procedure for extensive destruction of multiple vertebral bodies due to spinal infections may be limited, which needs further clinical investigation. Also, the guidelines for the use of antibiotics after this procedure should be established by future studies with a large sample size. Clinical trials of this technique for tuberculosis infection or fungal infection of the spine are now underway. The clinical results of this technique for tuberculosis infection of the spine will be reported in the near future.

■ Key Points

- Clinical results of posterolateral spinal endoscopic debridement and irrigation followed by percutaneous drainage in 15 consecutive patients with pyogenic spondylodiscitis were investigated.
- Immediate pain reduction and early subsidence of spinal infection after surgery could be achieved.
- This procedure can be applied even to patients with multiple comorbidities, who are not candidates for major spinal surgery under general anesthesia.

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