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Case Report

Lateral Lumbar Interbody Fusion with Percutaneous Pedicle Screw in Combination with Microendoscopic Laminectomy in the Lateral Position for Lumbar Canal Stenosis

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A minimally invasive surgical (MIS) procedure is an ideal surgical procedure. Many MIS techniques have been reported in spinal surgery. In clinical practice, we often encounter two-level canal stenosis cases, in which one level shows instability and the other does not. In such a case, fusion surgery for one level and decompression surgery for the other level is ideal. LLIF/OLIF approached from the lateral side has been reported effective. MIS decompression techniques in the lateral decubitus position have never been reported. We devised a surgical method that can accomplish both fixation and decompression in a consistent lateral decubitus position.

Key words: microendoscopic surgery, lateral position, navigation, minimally invasive surgery, image free

A minimally invasive surgical (MIS) procedure that leads to quick patient recovery and fewer complications is an ideal surgical procedure. Many MIS techniques have been reported in the field of spinal surgery, and their use is spreading in clinical practice [1-6], For example, a number of MIS fusion surgeries for instability have been reported, including transforaminal lumbar interbody fusion, lateral lumbar interbody fusion [LLIF], oblique lumbar interbody fusion [OLIF], and anterior lumbar interbody fusion. Among them, LLIF/OLIF approached from the lateral side has been reported to be effective [7]. Meanwhile, MIS decompression has been reported in cases with lumbar canal stenosis without intervertebral instability (as imaged by microscopic, microendoscopic, or percutaneous endoscopic discectomy, *etc.*) [8]. However, in clinical practice, we often encounter two-level canal stenosis cases, in which one level shows instability and the other does not. In such a case, performing fusion surgery for one level and decompression surgery for the other level is ideal, and these surgeries can be performed by combining two different MIS techniques. MIS fusion procedures performed in the lateral decubitus position have been reported, but MIS decompression techniques in the lateral decubitus position have never been reported. Therefore, it is thought that if surgeons do not select a fusion technique performed in the prone position, an intraoperative posture change will be required. When using an image intensifier, an additional problem is radiation exposure. To solve this problem, we devised a surgical method that can accomplish both fixation and decompression in a consistent lateral decubitus position without the need for an image intensifier or posture change, which we performed in a patient with lumbar canal stenosis.

Case Report

This report was conducted with the approval of the

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ethics committee of Okayama Rosai Hospital. The patients whose case reports are described provided informed consent.

Medical history and physical examination. A 72-year-old woman presented at our department with a complaint of low back pain and lower extremity pain which had started 10 years earlier and grown progressively worse. She had been undergoing conservative treatment with a family doctor for this condition. She had felt lower-extremity pain in a standing position from 3 months before her visit. Physical examination revealed lumbago during body motion; numbness in both legs appeared after standing for a few seconds, and she could not walk long distances. Mild muscle weakness of the left extensor hallucis longus muscle (MMT 4) and hypoesthesia in both L5 areas were noted. There was no abnormality in deep tendon reflex.

The patient had polymyalgia rheumatica 1 year prior to presentation, for which she had taken 5 mg/day oral prednisolone (PSL). She was also taking 35 mg/week alendronate for osteoporosis.

Radiographic findings. On dynamic radiography, a posterior opening of the L3/4 intervertebral disc was observed. Magnetic resonance imaging revealed L3/4 and 4/5 spinal canal stenosis in the sagittal view, and a redundant nerve was recognized on the cranial side from L3/4 (Fi. 1).

Clinical diagnosis and surgical indication. Symptoms were caused by a two-level lumbar spinal canal stenosis, which included an unstable L3/4 level and a stable L4/5 level. In this case, we thought fusion surgery for the L3/4 level and decompression surgery for the L4/5 level were desirable. When fusion surgery is performed with PLIF or TLIF, there is the merit that there is no postural change for endoscopic depression in the prone position. However, in open PLIF or TLIF surgery, it is necessary to dissect the enthesis of the back muscles and the cage inserted into the intervertebral disc is smaller than the cage inserted with the LLIF. We considered how best to minimize the invasiveness and anesthesia time, arriving at the choice of micro-endoscopic decompression surgery in the lateral decubitus position. Although endoscopic surgery and orientation are not the standard procedures for such a case, we considered that navigation could be used to elucidate the anatomy. Doing away with the requirement of postural change would lead to a shorter operation and anesthesia time. We explained the surgery to the patient and she provided her informed consent.

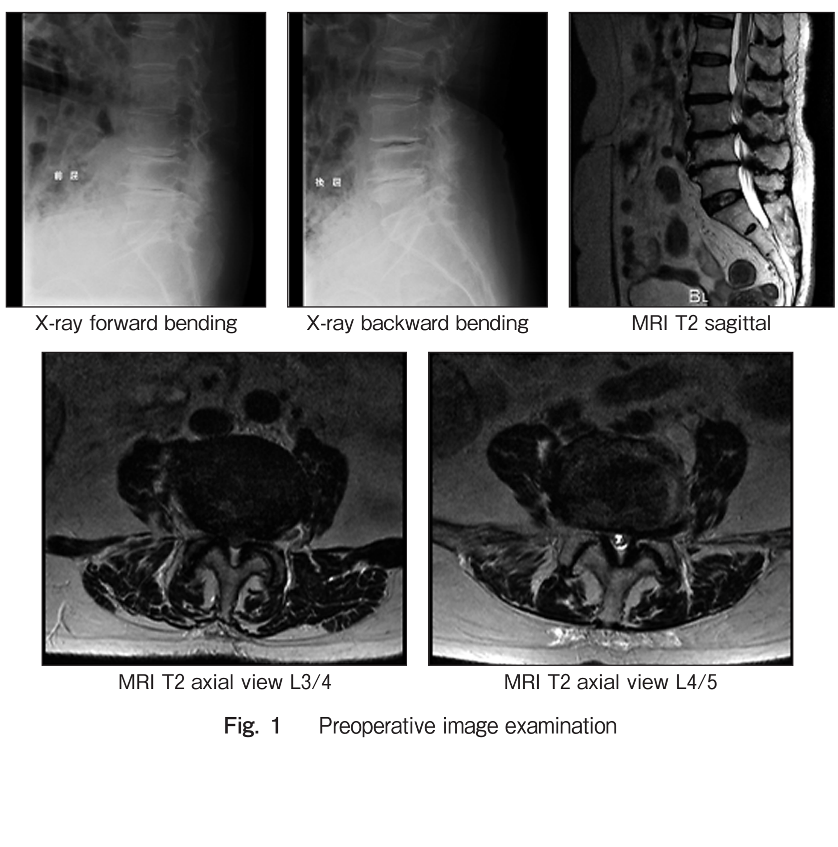

Fig. 1 Preoperative image examination

Surgical technique and operative procedure

1. Surgical position. After the induction of general anesthesia, the patient was placed in the lateral decubitus position on the upper left of a hinged Jackson bed (ProAxis® Spinal Surgery Table; Mizuho OSI, Union City, CA, USA) (Fig. 2). To loosen the psoas major muscles, both hip joints were flexed, and a pillow was placed in the right axilla to depressurize the brachial nerve. Then, we positioned the bed to render the spinal column straight and slightly rotated the patient from the lateral decubitus position to the prone position direction. The patient's chest, pelvis, and lower limbs were fixed to the bed using tape. We added a pad in front of the patient's sternum to rotate the bed during surgery.

2. Bony harvesting and CT. The surgeon stood on the dorsal side of the patient and made a skin incision of about 4 cm on the left posterior superior iliac spine (PSIS). We harvested an auto-bone graft from the left PSIS using a chisel, and after hemostasis, we inserted a percutaneous reference arm of the navigation system (Stealth Station® S7; Medtronic Japan, Tokyo) to the same site. Then, the O-arm® Surgical Imageing System (Medtronic Sofamor Danek, Memphis, TN, USA) was used for intraoperative CT imaging of the operative field.

3. Establishment of the surgical channel through the lateral position. The surgeon stood on the ventral side of the patient and confirmed the position of the skin incision that was most suitable for approaching the L3/4 disc using the navigation pointer. An approximately 4-cm skin incision was made, and the outer and inner oblique muscles fascia were dissected with scissors and spread with a Langenbeck's retractor. The abdominal transverse muscle was bluntly divided with s gauze ball and fingers and approached the retroperitoneum. After preparing the retroperitoneal space on the front edge of the psoas major muscle, the first dilator was placed under the navigation system at the optimal position of the L3/4 intervertebral disc and the retractor was positioned using a serial dilator and was fixed with a pin. During the operation, the navigation system was available in real time. We spread the soft tissue remaining on the L3/4 disc bluntly, then additionally installed an antero-posterior retractor, after which the intervertebral disc was ready for direct view. Thereafter, the L3/4 intervertebral disc was incised with a knife, the intervertebral disc and the endplate were removed with the shaver, and the end plate was peeled off using the navigated Cobb retractor and was removed using a

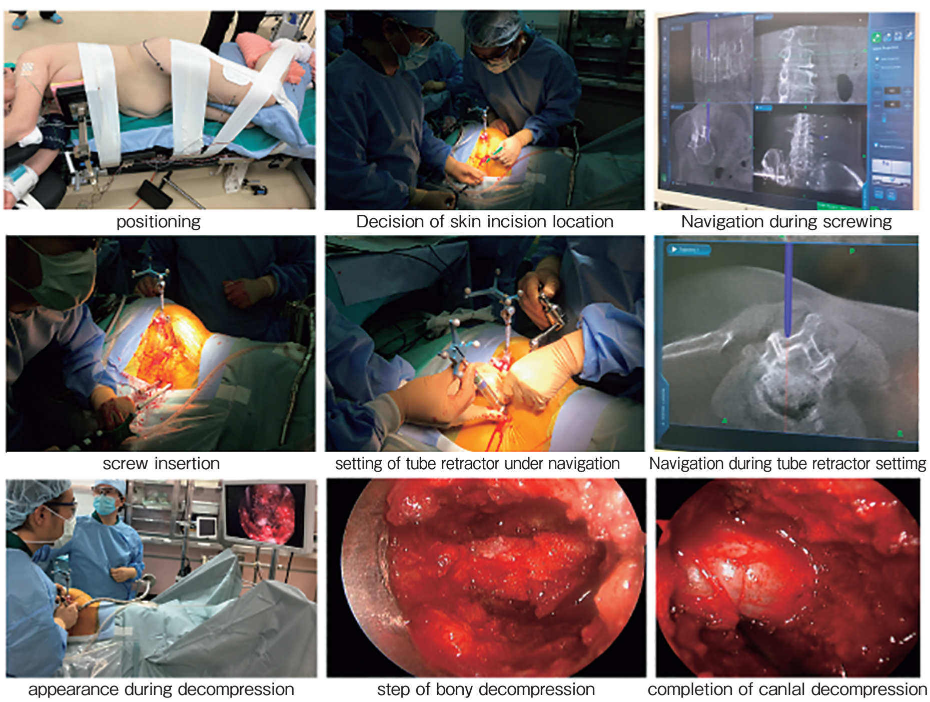

Fig. 2 Intraoperative procedure.

nucleus pulposus forceps. After trial insertion under the navigation system, the cage was inserted.

4. Microendoscopic bilateral decompression with a unilateral approach in the lateral position. We did not change the position of the patient, but rotated the bed in a direction approaching the prone position. The surgeon stood at the back side of the patient, and the location of the L4/5 intervertebral level was confirmed under the navigation system. A skin incision of about 2 cm was made, and a further incision was made in the same direction up to the fascia. We used the METRx® system (Medtronic Japan) for this technique. The surgeon set the tubular retractor using the first dilator under the navigation system using the serial dilator. The orientation can be determined by referring to both the screen of the endoscopic field and the navigation system's monitor. We removed the bone with the navigation system's surgical drill and a high-speed drill (Midas Rex®; Medtronic Japan), and we used Kerison's forceps on the adhesion part of the yellow ligament and excised as much as possible. Decompression of the dural sac and the L5 nerve root was confirmed.

5. Minimally invasive percutaneous pedicle screw insertion. The surgery was continued with the patient in the lateral position. The pedicle screw insertion sites at both L3 and L4 levels were confirmed by the navigation system, which was also used when the pedicle screws were inserted. Finally, the rods were inserted through the orbit of the pedicle screws.

Results

No obvious complication (vessel injury or spinal nerve injury) occurred during the operation and the wound healed well. The operation time, estimated blood loss, and hospital stay after surgery were 156 minutes, 150 mL, and 17 days, respectively.

In the clinical assessment, the Oswestry Disability Index (ODI) was decreased at final follow-up compared to that before the operation (ODI score, 8.9 vs 4.4). Postoperative CT revealed that all pedicle screws were inserted correctly in each pedicle, that the L4/5 facet joints were preserved, and that sufficient decompression was obtained by microendoscopic decompression (Fig. 3).

Discussion

In this case, treatment could have been done using either a conventional posterior surgery or a lateral sur-

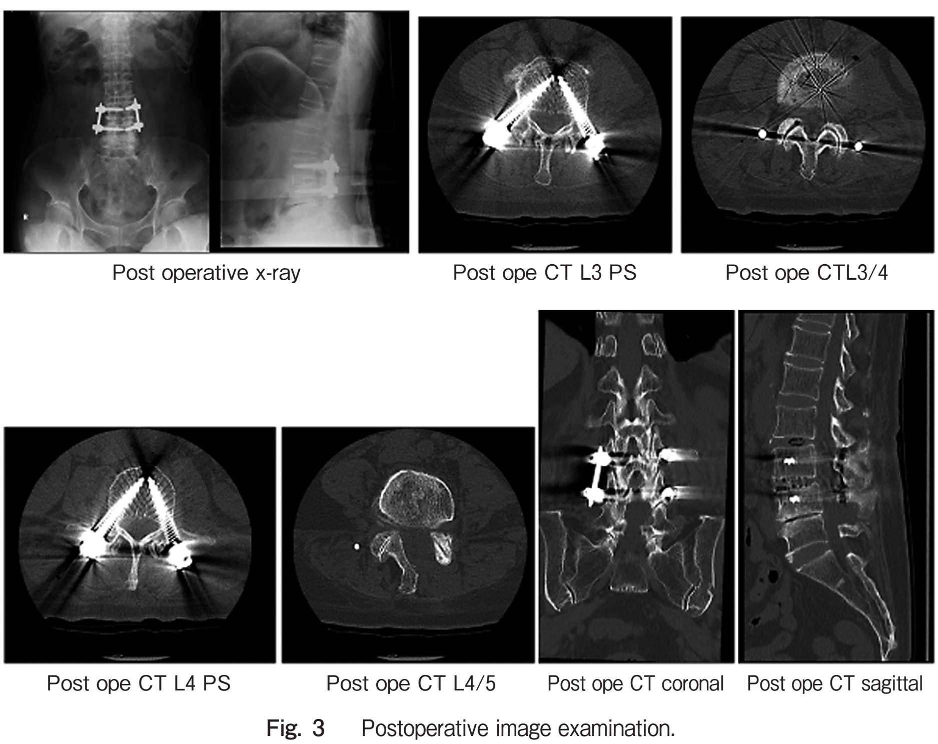

Fig. 3 Postoperative image examination.

gery. Compared to the conventional posterior fusion surgery, lateral fusion surgery requires needs less retraction of the back muscles, so there are fewer back muscles injuries, and it also requires the insertion of a large cage, which leads to less cage subsidence in, especially in patients with osteoporosis. Moreover, since it is possible to insert a high cage, it is easy to achieve a suitable lordosis of the lumbar vertebrae. However, the combination of endoscopic decompression techniques in the lateral decubitus position and fixation has never been performed.

Although LLIF is an operation performed in the lateral decubitus position, use of a navigation system is useful during the approach, during the installation a retractor, when shaving the intervertebral disc and when inserting a cage. An accurate approach reduces unnecessary muscle resection, and accurate retractor installation avoids damage to the large vessels, the spinal canal, and the lumbar nerve plexus. In addition, accurate insertion of a large cage can avoid damage to the end plate of vertebral bodies.

Many reports have described the usefulness of a CT-based navigation system (O-arm®) during surgery, along with its many advantages, such as high precision, lack of radiation exposure, and short shooting time [9-11]. The navigation system makes percutaneous pedicle screw (PPS) insertion in the lateral position safer because it makes it possible to confirm the axial CT.

When installing a tube retractor and using a high-speed bar, the navigation system makes it possible to confirm the position of the lamina arc or tip of the drill in real time. Unlike in conventional micro endoscopic laminectomy (MEL), the operator stands on the other side of the tube retractor. Although the patient's posture was different, the navigation system provided an accurate orientation and made the surgery possible.

Using the navigation system, it is possible to insert the cage, PPS, and tube retractor and to remove the lamina arch without an image intensifier.

Because there is no position change and only one navigation shooting is needed, the operation time and anesthesia time can be shortened. In addition, the image-free surgery does away with thethe surgeon's radiation exposure. The disadvantage is that the direction of the surgical site is different from the usual direction and orientation is difficult. Since the relationship between the patient and the endoscope is the same as in the prone position, the surgical field shown on the monitor is not much different from the operation field used in the prone position. However, the handling is different from the handling in the prone position surgery namely, the direction and orientation are determined clearly by both the navigation system and checking of the endoscope monitor. It was expected that decompression on the floor side would become difficult when there are many bleedings from the epidural space. Therefore, we took care during the operation not to damage the epidural fat and blood vessels and performed the hemostasis very deliberately. In this case, the O-arm imaging functioned as a highly accurate navigation guide and could be used for endoscopic surgery using LLIF, PPS insertion, and a tubular retractor while in the lateral position.

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