



# Microendoscope-assisted posterior lumbar interbody fusion: a technical note

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**Background:** Various surgical options for lumbar interbody fusion have been reported. Minimally invasive techniques are widely used to reduce soft tissue damage. Here, we report our novel technique of microendoscope-assisted posterior lumbar interbody fusion (ME-PLIF) using an 18-mm tubular retractor system (METRx, Medtronic Sofamor Danek, Memphis, TN, USA) for lumbar spine degeneration treatment.

**Methods:** Between January 2011 and December 2011, 48 patients underwent one level ME-PLIF by a surgeon in our hospital. We followed up 46 patients (95.8%). A 20-mm skin incision was made in the craniocaudal direction at the level of the intervertebral disc, 15 mm outside the midline (symptomatic side). The surgeon placed the tubular retractor and performed decompression, thoroughly discarded the intervertebral disc, and then inserted the autologous crushed bone on the opposite side. Subsequently, a cage was inserted using fluoroscopic guidance. Following the end of the microendoscopic operation, pedicle screws (PS) were inserted percutaneously using fluoroscopic guidance. Clinical outcomes were evaluated using the Oswestry Disability Index (ODI) and the Japanese Orthopedic Association (JOA) scores. For radiological outcomes, fusion rates based on the Bridwell fusion grading system were evaluated using plain radiography or a computed tomography scan at the most recent follow-up timepoint.

**Results:** The mean age was 61.4 (range, 36.0–86.0) years, the mean operation time was 102 (range, 59–162) min, and the mean blood loss was 86 (range, small amounts–315) mL. The average pre- and post-operative ODI scores were 22.1 and 9.7, respectively, with an improvement rate of 56.1%, and the pre- and post-operative JOA scores were 9.8 and 16.4, respectively, with an improvement rate of 50%. There were no cases of pseudarthrosis. One case (2.2%) had a deep wound infection that required total removal of the implants. Four (8.7%) cases had a dural tear and required dural sutures under microendoscopy, though they had good recovery.

**Conclusions:** This technique yielded good results. The advantages of using only the microendoscope were: (I) better visual field and (II) higher operability (it was possible to change the tubular retractor to various angles; this was difficult under direct viewing or under a microscope). These features are considered to lead to reduce soft tissue damage. Although long-term follow-up results are needed, this appears to be a safe and minimally invasive treatment option for lumbar spine degeneration.

**Keywords:** Lumbar interbody fusion; minimal invasiveness; microendoscope; tubular retractor

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## Introduction

Surgical interbody fusion is an effective treatment option to stabilize the motion of the painful segments and to provide decompression of the neural elements. There are several surgical options available for lumbar interbody fusion, and each technique has its own inherent advantages and disadvantages (1).

Traditional open surgery techniques for posterior lumbar fusion are widely accepted methods, but many authors have documented adverse effects of the extensive tissue damages. In 2003, Foley *et al.* (2) described minimally invasive transforaminal lumbar interbody fusion (MI-TLIF), subsequently many publications have reported the advantages of such an approach, with good outcomes (3-7).

Since 2008 we have performed microendoscope-assisted posterior lumbar interbody fusion (ME-PLIF) using an 18-mm tubular retractor. The technique includes all steps (decompression, curettage of the endplate, bone grafting, and insertion of the cage), other than pedicle screw (PS) insertion, uses only a microendoscopic system, and has not been reported on so far. The purpose of this study is to document the new technique and the clinical and radiological outcomes.

## Methods

Between January 2011 and December 2011, a total of 48 patients underwent one level ME-PLIF performed by a surgeon (H Inanami) in our hospital, and we followed up 46 patients (95.8%). All of them underwent ME-PLIF using the tubular retractor system (METRx, Medtronic Sofamor Danek, Memphis, TN, USA). The minimum follow-up period was 25 (range, 25–39) months. All patients had a pre-operative evaluation with plain lumbar spine radiography, magnetic resonance (MR) imaging, and a computed tomography (CT) scan. The indications for surgery were spondylolisthesis, spondylolysis, degenerated disc disease (DDD), intra-extra foraminal stenosis, and lumbar disc herniation. Both during the perioperative period and post-surgery, the patients were monitored for complications and were followed regularly by the surgeon (e.g., for intraoperative faults, cage migrations, new or worsening neurological deficits, wound infections, etc.). For clinical outcomes, the Oswestry Disability Index (ODI) and the Japanese Orthopedic Association (JOA) scores were used to assess the pre-operative and post-operative (2 years post-surgery) pain and disability status of the

patients. For radiological outcomes, the fusion rates based on the Bridwell fusion grading system (5,8) were evaluated using plain radiography or a CT scan at the most recent follow-up point. All data were collected prospectively, and this study is a retrospective review of the data.

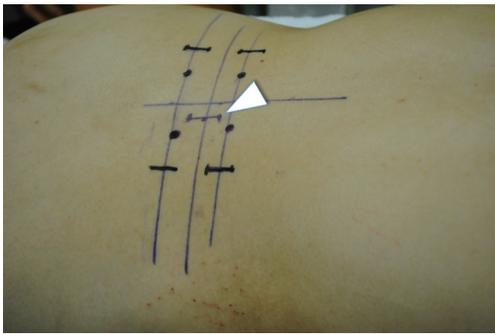
## Surgical technique

First, we start with the decompression. The level of the intervertebral disc was marked, and a 20-mm incision was made into the skin 15 mm outside from the midline on the symptomatic side (*Figure 1*). Using fluoroscopic guidance, the tubular retractor (18 mm) was placed on the lamina-facet junction overlying the disc space, and the operation was performed with the microendoscope connected to the tubular retractor. Subsequently all the inferior articular process and part of the superior vertebra were resected using a chisel until the flavum was removed. When the superior articular process appears, part of the superior articular process and part of the inferior vertebra were removed using a chisel and Kerrison rongeur until the root was decompressed sufficiently. This process allows for direct neural decompression, and the nerve root could be gently retracted medially. After the decompression was completed, the intervertebral disc was thoroughly removed using an angled curette, a ring curette to the opposite side (*Figure 2*). The autologous bone was crushed and was then inserted using the bone funnel (*Figure 3*). If the autologous bone was inadequate, a granular artificial bone was also used. Subsequently, a boomerang type cage was inserted using fluoroscopic guidance. Following ending of the microendoscopic operation, screws were inserted percutaneously using fluoroscopic guidance (*Figure 4*). Compression is applied to this construct before final tightening, restoring lordosis and providing compression of the bone graft in the middle column.

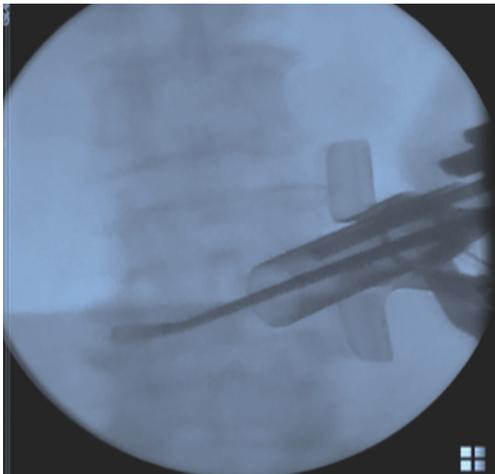
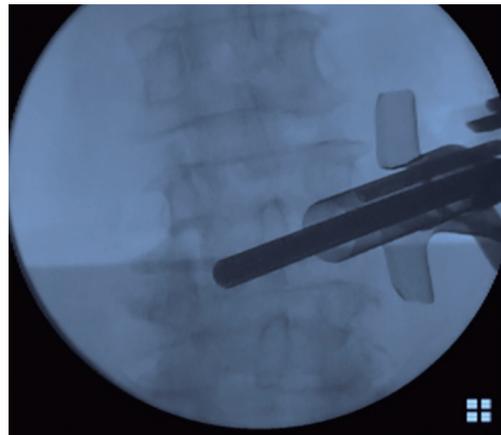
## Results

The mean age of the patients was 61.4 (range, 36.0–86.0) years, and the ratio of men to women was 27 to 19. The group consisted of 2 patients who were operated on at L3/4, 29 at L4/5, and 15 at L5/S1. The mean operation time was 102 (range, 59–162) min, and the mean blood loss was 86 (range, small amounts–315) mL (*Table 1*).

The clinical data collected prior to and post-ME-PLIF are presented in *Table 2*. The average pre- and post-operative ODI scores were 22.1 and 9.7, respectively,

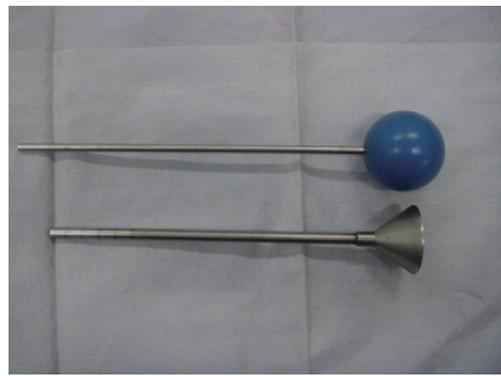


**Figure 1** Skin incision at the level of the intervertebral disc outside the midline (symptomatic side) (arrowhead).

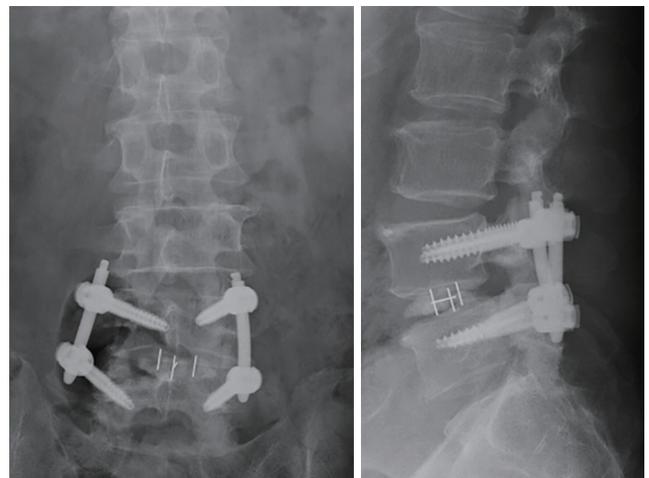


**Figure 2** The intervertebral disc is curetted away to the opposite side using an angled curette and a ring curette.

with an improvement rate of 56.1%. The pre- and post-operative JOA scores were 9.8 and 16.4, respectively, with an improvement rate of 50%. Regarding the radiological outcomes, 31 cases had a grade 1 fusion, and 14 cases had a grade 2 fusion based on the Bridwell fusion grading system.



**Figure 3** The autologous bone is inserted in the opposite side using the bone funnel.



**Figure 4** Screws are inserted percutaneously using fluoroscopic guidance.

**Table 1** Patient characteristics

Characteristics	Values
Age, years	61.4
Sex, men:women ratio	27:19
Level of fusion, n	
L34	2
L45	29
L5S1	15
Operating time, min	102
Blood loss, mL	86

**Table 2** Clinical outcomes

Clinical outcomes	Preop	Postop (2 years)
ODI	22.1	9.7
JOA	9.8/23	16.4/23

Preop, pre-operative; postop, post-operative; ODI, Oswestry Disability Index; JOA, Japanese Orthopedic Association.

**Table 3** Radiological outcomes (Bridwell anterior fusion grading system)

Grade	Description	No.
1	Fused with remodeling and trabeculae present	31
2	Graft intact, not fully remodeled and incorporated, but no lucency present	14
3	Graft intact, potential lucency present at top and bottom of graft	1
4	Fusion absent with collapse/resorption of graft	0

**Table 4** Complications

Complications	N (%)
Pseudarthrosis	0 (0)
Cage migration	0 (0)
Deep wound infection	1 (2.2)
Revision surgery	1 (2.2)
Dural tear	4 (8.7)

There was one grade 3 case, which required revision surgery owing to infection. There were no grade 4 cases (*Table 3*). We identified one case in which the vertebral body moved 3 mm or more on functional imaging, and one in which the transparency around the PS occurred as pseudarthrosis, though there were no cases of pseudarthrosis.

Regarding complications, 1 case (2.2%) developed a deep wound infection, which became obvious 2 weeks post-surgery and revision surgery was performed to remove all implants. Four (8.7%) cases had a dural tear and required dural suturing using the aid of a microscope, though they experienced no severe nerve damage. There was no incident of cage migration (*Table 4*).

## Discussion

Our new procedure, ME-PLIF, which was performed from decompression to the insertion of the cage using a microendoscopic system, was considered to be a beneficial method. While MI-TLIF is under direct view or uses a microscope, ME-PLIF is performed under a microendoscope. The use of the microendoscope makes it possible to obtain smaller skin tears and a good field of view. In addition, it is possible to change the tubular retractor to various angles (this is difficult under direct viewing or under a microscope), and the operation on the opposite side becomes easy. On the other hand, so far, many reports on MI-TLIF have been produced since Foley *et al.* first described the technique in 2003 (2), and stable results have been shown using this method. Basically, sequential dilators are used, and the distal end of a 22- or 26-mm diameter tube of appropriate length is positioned over the facet joint complex. Interbody is inserted into the disc space via the METRx tube. The tubular retractor is removed, and a PS-rod construct is inserted. Compared to open surgery, reduced bleeding, a shorter operation time, and greater improvements in post-operative outcomes have been reported with MI-TLIF (3-7). On the other hand, the microendoscopic discectomy (MED) has been used as a minimally invasive surgical method to treat lumbar herniated discs since 1997, when it was first introduced by Foley and Smith (9). Good outcomes have been reported using this method (10,11). We hypothesized that combining these two methods would result in a less invasive procedure.

We performed all steps, except PS insertion, using only

a microendoscopic system called the METRx (Medtronic Sofamor Danek, Memphis, TN, USA). The use of an 18-mm tube makes it possible to make small incisions. In addition, the operation time and blood loss are minimal compared to the past reports of MI-TLIF by Park *et al.* (3) and Peng *et al.* (5). The microendoscope has a better visual field and is easier for the surgeons to handle compared to the microscope. But the two-dimensional view and hand-eye spatial separation of the microendoscopic view can also be extremely disorienting (10). Ensuring satisfactory technique will obviously require additional training and experience. The patients showed more improvements in their ODI and JOA scores post-surgery compared with their pre-operative scores. In our case, no case of pseudarthrosis or cage migration was found. This suggests that this procedure may enable thorough curettage of the cartilage endplate and bone grafting. Park *et al.* reported that solid fusion could be achieved using minimally invasive techniques in the same way as the traditional open surgery approach (3). The rate of dural tear was 8.7% (4/46) in our study, on the other hand, Park *et al.* reported a 0% in 32 cases (3), thus, our rate of dural tear was high. All cases required dural suturing using the aid of a microendoscope, and they experienced no severe nerve damage. However, we will need to do more techniques carefully. The infection rate was 2.2% (1/46) in our study, with one case requiring implant removal. On the other hand, Parker *et al.* reported a 0.6% infection rate in 362 cases from ten papers included in a systematic review (12); thus, our infection rate was somewhat high. The limitations of this study were: (I) that the follow-up period was insufficient, and (II) there was no control group in which the same surgeon performed MI-TLIF or used a traditional open surgery technique. The results from this study are positive, and ME-PLIF may be a good, minimally invasive option for posterior surgery.

## Conclusions

The short-term use of our novel technique, ME-PLIF using only a microendoscopic system, provides satisfactory results. Although knowledge about long-term outcomes is needed, this appears to be both a safe and minimally invasive option for the treatment of lumbar spine degeneration.

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helped collect patient data.

## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Ethical Statement:* This study was approved by ethics committee of the Iwai Medical Foundation, and informed consent was obtained from the patients for publication of this study and any accompanying images.

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