Beginner’s Consecutive Series of Lumbar Microdiscectomy during Neurosurgical Training
—5 year Outcome of Beginner’s Pitfalls and Comparison with the Other Series

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Abstract

There is no study that compares the beginner with the more experiences about the postoperative results of lumbar microdiscectomy.

The object of this study is to investigate the outcome after lumbar microdiscectomy performed by a beginner in spinal surgery, compared to the other series.

A consecutive series of 86 patients were followed for a mean of 57 months in the 83 of them. We used both axial and sagittal direction for classifying the herniation according to computerized tomography and/or magnetic resonance image. Preoperatively, we identified several special conditions, as recurrent disc herniation at the same level and on the same side, lateral recess stenosis, axillar or extraforaminal types of herniations and congenital lumbosacral anomaly. In the axillar type, the fragment of disc was removed through the axilla. Medial type was performed by the hemilateral approach on the dominant symptom side. Extraforaminal disc herniations were approached from the midline via submuscular dissection going laterally to the intertransverse window. Recurrent herniation at the same level and on the same side was approached via an extended approach from the scar-free dura. Outcomes were assessed using Oswestry Disability Index (ODI).

At final follow-up, the mean ODI was 11.4. Eighty one percent had minimal disability and 8% had moderate disability. The success rate was 89%. The recurrence rate and reoperation rate were 3.6% respectively.

Even the beginner in spinal neurosurgery can perform safe microdiscectomy under appropriate supervision for every type of herniation. The precise analysis and planning of the operation yields good results.

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Key words
lumbar, microdiscectomy, ODI, disc, herniation

Introduction

Recently we have often noticed that patients prefer their operation performed by an expert rather than a beginner or refuse an operation to be done by a beginner. Lumbar microdiscectomy is especially performed by a beginner in spinal surgery as microsurgical training. However, we have never seen a study that encourages the performance the operation by beginners. There is also no study that compares the beginners with other series on postoperative results. This study was undertaken to investigate the outcome after lumbar microdiscectomy of the beginner spinal surgeon, compared with the other series, and some pitfalls of surgical and diagnostic procedures.

Patients and Method

Background of the beginner

The “beginners” consecutive series of 86 microsurgical cases were operated by the primary author (N.K.) from
January 2003 to June 2004. N. K. had never operated on the lumbar spine previously, even if he had experience already during his general neurosurgical training (except spine surgery) for 9 years. In Giessen, he experienced 15 cases of cervical anterior fusion and 20 cases of lumbar canal stenosis as a surgeon, in addition to 240 spinal surgical cases as assistant during his spinal surgical training period.

2 System of surgical education

In our department, a beginner must participate in over 50 cases of lumbar microdiscectomy as first assistant. After that he is allowed to perform the surgery under supervision. The beginner operator discusses surgical strategy with the supervisors before each surgery. The Board certified Neurosurgeon can perform microdiscectomy alone. The author has been the considered a “beginner” in Giessen because who had never experienced lumbar surgery before, though the author had Japanese Neurosurgical Board certification.

3 Selection of patients and surgical preparations

All patients had lumbar disc herniation that was surgically indicated due to intractable pain and/or neurological deficit. The surgical cases for the operator were distributed at random except for cases of recurrence and extraforaminal types from among the 700 lumbar disc surgical cases/year in our department.

Age and sex of patients were from 23 to 75 years old (mean 48 years), and they were 45 men and 41 women. Indications for surgery were intractable radicular pain \( (n=85) \), paresis or sensory disturbances due to nerve root compression \((n=58)\). Surgical levels included two cases at L2/3, seven cases at L3/4, 36 cases at L4/5, 33 cases at L5/S1 and eight cases with congenital lumbosacral anomaly. In these eight cases, four cases had 6 lumbar type vertebrae and four cases had 4 lumbar type vertebrae. The disc herniations were evaluated both in axial and sagittal planes according to computerized tomography (CT) and/or magnetic resonance image (MRI). In addition, there were some special conditions, such as recurrent disc herniation at the same level and on the same side in six cases and lateral recess stenosis in 10 cases. In the sagittal plane caudal herniation was seen in 44 cases including four axillar type cases, 19 medial cases and 23 cranial migration cases. In the axial plane, there were seven medial cases, 70 mediolateral cases, eight extraforaminal cases and one posterior epidural migration case. Patient’s records were evaluated for signs and symptoms leading to the decision for surgical treatment.

4 Surgical Technique

Every case was operated together with supervisors of the department. In all cases, the surgical level was confirmed by a sagittal scout view on CT or MRI and both anteroposterior (AP) and lateral plain radiographs. The level marking was performed by not only AP but also lateral view on fluoroscopy in the operation room.

The surgical position was prone with the "Giessener Bock".

In the sagittal plane, the herniations were classified into three categories: dislocation of the sequestrated hernia in the cranial, caudal, or no dislocation respectively. The cranial or caudal migration disc fragments required extension of the hemilaminotomy in the cranial or caudal direction respectively.

In the axillar type, the fragments of disc were removed through the axilla. After partial decompression, it became easy to retract the nerve root medially and to complete the nerve root decompression. In axial direction, every medial type of herniation had bilateral root compression at the same level. This type was removed not by the bilateral, but hemilateral approach on the dominant symptom side. All cases bilateral root compression recovered from their symptoms after surgery. Extraforaminal (lateral) disc herniations were approached from the midline via submuscular dissection going laterally to the intertransverse window and duplicate roots were not found during surgery. In this series six patients were operated for recurrent herniation, defined as being at the same level and on the same side. A recurrent herniation was approached through an extended approach: dissection was performed from scar-free dura to the nerve root and the herniated disc material. No attempt was made to remove all scar tissue. Herniations in combination with lateral recess stenosis were seen in a total of 10 cases, one case at L3/4, five cases at L4/5 and four cases at L5/S1. These cases required more extended partial medial facetectomy in order to achieve sufficient nerve root decompression.

5 Postoperative evaluation

Postoperatively the patients were routinely examined on the first day, at discharge, and at six weeks. They had
a physical examination or telephone interview at follow up, which was 4 to 5 years postoperatively. The late follow up was recorded by the second author (M.S.) who independently interviewed the patients and who was not involved in their treatment.

## Results

### Operation time

Operation time was from 45 to 181 minutes (mean 82 minutes). The passage of operation time showed a gradual tendency to shorten (Fig. 1). The 58th microdiscectomy took 181 minutes because dural tear was repaired.

### Complications and outcome

One surgical complication was a dural tear without compromise to the nerve root. It was repaired by suturing without any deficit addictional. At final follow-up, the mean ODI was 11.4 (range, 0 to 76). Sixty-seven patients (81%) had minimal disability (0 to 20), seven (8%) moderate disability (21 to 40), seven (8%) severe disability (41 to 60), and two (2%) were disabled (61 to 80). The recurrence and reoperation rates were 3.6% (three patients), respectively. Three patients had recurrent surgery for recurrent herniation at the same level, making a reoperation rate of 3.6% for the 83 patients following the long-term follow-up. Each recurrent surgery was performed at three months, 54 months, and 57 months respectively after the initial discectomy. According to the type of herniation, the ODI was 32 in the recurrent, 10.5 in the axillary, 12.7 in the cranial, 6.2 in the medial (in the sagittal), 12.9 in the caudal, 11.7 in the mediolateral, 1.4 in the medial type (in the axial) and 20.7 in the extraforaminal type (Table 1).

### Discussion

#### Pitfalls of the beginner surgeon

The extraforaminal type was approached by paraspinous submuscular dissection to approach the intertransverse window. As the notice for this approach, surgeon needs to recognize the possibility of duplicate roots in the extraforaminal field. Because the intertransverse window is a narrow space, it is difficult to distinguish tense duplicate roots and a sequestration even under the microscope. Duplicate extradural roots can be type II of Neidle and MacNab's classification of furcal nerve roots. Haijiao et al. reported that the incidence of furcal nerve roots was 15.1%.

Posterior epidural migration type is extremely rare. There are only 15 cases of this migration reported in the lumbar spine. Our case was a posterior epidural migration at L2/3 causing acute cauda equina syndrome. At the follow up examination after 1 year, the patient had almost fully recovered. The diagnosis of the sequestered disc is difficult to establish and to distinguish it from other extradural mass lesions before surgery on CT scans, but MRI may be more helpful. Sometimes, with upward or downward migrated herniation, it is difficult to recognize the original level of the dislocated herniation. That is best demonstrated by the sagittal MRI views.

Of the four cases of axillary type, two at L4/5 and two cases were at L5/S1. In every case the hernia was classified as downward migrated in the sagittal plane and as mediolateral herniation in the axial plane. Because in this type it may be impossible to retract the nerve root medially, the disc fragments are removed through the axilla. It becomes easy to retract the nerve root medially after partial decompression through the axilla, and the nucleotomy.

### Table 1 Outcome of every type of herniation

<table>
<thead>
<tr>
<th>Type of herniation</th>
<th>No. (No. was followed)</th>
<th>ODI score at final</th>
<th>Recurrence number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent</td>
<td>6 (5)</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>Cranial</td>
<td>23 (21)</td>
<td>12.7</td>
<td>0</td>
</tr>
<tr>
<td>Medial in sagittal plane</td>
<td>19 (18)</td>
<td>6.2</td>
<td>2</td>
</tr>
<tr>
<td>Caudal</td>
<td>44 (43)</td>
<td>12.9</td>
<td>1</td>
</tr>
<tr>
<td>Mediolateral</td>
<td>70 (66)</td>
<td>11.7</td>
<td>3</td>
</tr>
<tr>
<td>Medial in axial plane</td>
<td>7 (7)</td>
<td>1.4</td>
<td>0</td>
</tr>
<tr>
<td>Extraforaminal</td>
<td>8 (8)</td>
<td>20.7</td>
<td>0</td>
</tr>
<tr>
<td>Axilla</td>
<td>4 (4)</td>
<td>10.5</td>
<td>0</td>
</tr>
</tbody>
</table>

ODI : Oswestry disability index.
is then performed in the usual manner. It is necessary to be careful when removing the herniation from the axilla because usually there is a vein which may cause disturbing bleeding and moreover it is possible to tear the dura if the fragment of disc is not pulled out from caudal side. Prestar et al\textsuperscript{13} reported three cases of intradural lumbar disc herniations in which the free disc fragment had penetrated the dural sac from the axilla of the nerve root in two of them. So, the axilla may be a site of low resistance to the presence of herniated.

The recurrent lumbar disc herniation is defined generally as disc herniation at the same level, regardless of ipsilateral or contralateral location\textsuperscript{14–16}. All recurrent cases in this series (at the same level on the ipsilateral side) were diagnosed by MRI scan with and without gadolinium enhancement in order to differentiate between disc herniation and postoperative scar tissue. Recurrent herniation at the same level on the ipsilateral side is usually complicated by scar tissue. However, recurrent cases at the same level on the contralateral side usually have less scar tissue. It is important to approach the recurrent herniation from the normal dura outside the scar tissue for avoidance of dural tear. Swartz et al\textsuperscript{17} reported that it is easier to dissect laterally in the canal at the revision disectomy. Our methods or recurrent cases are as follows:

1 ) To expose normal dura by enlargement of laminotomy in caudal and cranial directions.

2 ) To expose the normal dura beneath the pedicle at the lateral rim of the spinal canal by a high speed diamond drill of few millimeters diameter.

This is most safely performed under the microscope. No attempt is being made to remove all scar tissue, because this bears the risk of damage to the nerve root and of dural tears. The scar tissue is dissected as appropriate caudally or cranially from the plane of the posterior longitudinal ligament just to expose the recurrent herniation, which is then easily removed.

Disc herniation in combination with lateral recess stenosis can cause radiculopathy even if the herniation is small. The lateral recess stenosis is usually caused by degenerative changes, especially by arthrosis of the intervertebral joints, but may also be due to congenital stenosis of the spinal canal. Therefore, this type can even occur in young patients. In this condition, it is important to totally decompress the lateral recess by resection of medial parts of the intervertebral joint and the yellow ligament. If the decompression is insufficient, the radiculopathy may not improve.

The Incidence of congenital lumbosacral anomalies is 4% ~30\textsuperscript{\%}.\textsuperscript{18–26} The congenital lumbosacral anomaly bears the risk of wrong level disc surgery\textsuperscript{27}. This situation is best recognized by both AP and lateral plain radiographs of the lumbar spine, which we perform routinely. In the operation room, the marked level is confirmed not only by AP view but also by lateral view on the fluoroscopy in our department. Further, Chan et al\textsuperscript{19} reported the function of lumbosacral nerve roots is altered in patients with lumbarized S1 so that the S1 nerve root serves the usual function of the L5 nerve root. In our cases, three patients with disc herniation at L5/L6 had L5 nerve root symptoms in all cases.

Other notes to beginners are as follows:

1 ) Take the plain lumbar plain X-ray films before the operation because surgery using only CT or MRI might be a level mistake.

2 ) Do not remove forcibly the degenerated disc near the aorta.

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<table>
<thead>
<tr>
<th>Author, year</th>
<th>ODI score at final</th>
<th>Success rate (%)</th>
<th>Recurrence rate (%)</th>
<th>Reoperation rate (%)</th>
<th>Follow period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loupasis, 1999</td>
<td>18.9</td>
<td>83</td>
<td>n.m.</td>
<td>7.3</td>
<td>12.2</td>
</tr>
<tr>
<td>Asch, 2002</td>
<td>26</td>
<td>78</td>
<td>n.m.</td>
<td>11</td>
<td>2.1</td>
</tr>
<tr>
<td>Palmer, 2002</td>
<td>16</td>
<td>93.9</td>
<td>3.1</td>
<td>3.9</td>
<td>1</td>
</tr>
<tr>
<td>Solberg, 2005</td>
<td>13.4</td>
<td>93.3</td>
<td>3.6</td>
<td>n.m.</td>
<td>1</td>
</tr>
<tr>
<td>Dewing, 2008</td>
<td>21.1</td>
<td>n.m.</td>
<td>3</td>
<td>3</td>
<td>2.2</td>
</tr>
<tr>
<td>Ruetten, 2008</td>
<td>24</td>
<td>n.m.</td>
<td>5.7</td>
<td>5.7</td>
<td>2</td>
</tr>
<tr>
<td>Ryang, 2008</td>
<td>12</td>
<td>n.m.</td>
<td>6.7</td>
<td>10</td>
<td>1.3</td>
</tr>
<tr>
<td>Present cases</td>
<td>11.4</td>
<td>89</td>
<td>3.6</td>
<td>3.6</td>
<td>4.8</td>
</tr>
</tbody>
</table>

ODI : Oswestry disability index, n.m. : not mention.
Clinical outcome

In general, most published reports accept that ODI below 40 is indicative of good outcomes (successes), whereas higher scores are considered partial or total failures. According to it, the success rate in this series was 89%. There was no great difference in our mean ODI at final follow-up compared with the mean ODI score of the normal population. In several studies (Table 2), the final mean ODI after microdiscectomy has varied between 12% and 26% in the follow-up between 12 months and 26 months. Our mean ODI tends to be better than other studies in spite of the long-term follow-up. On the other hand, recurrence rate and reoperation rate were 3.6%. Recent reported reoperation rate for recurrent herniation after microdiscectomy ranges from 3% to 13%.

Even the beginner can perform safe microdiscectomy under appropriate supervision even if the microdiscectomy are recurrent case and extraforaminal type. The good results are also related by the use of microscope, with which the beginner surgeon can experience the same operative field as the supervisor.

Conclusions

Even the beginner can perform safe microdiscectomy under the appropriate supervisor for every type of herniation. The precise analysis of the CT- or MRI-scans and precise planning of the operation yields good results, even in comparison with those of an expert.

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References