Comparative Study of the Outcomes of Endoscopic Unilateral Laminotomy for Bilateral Decompression (ULBD) With Destandau Technique and Microscopic ULBD: A Randomized Double-Blinded Study of 685 Patients

Paresh Chandra Dey¹, Nishit Palo², Abhishek Shukla³

¹Department of Orthopaedics, KIMS, Bhubaneswar, Odisha, India
²Department of Orthopaedics, Santosh Medical College & Hospital, Ghaziabad, India
³Department of Orthopaedics, Holy Family Hospital, Delhi, India

**Objective:** Lumbar canal stenosis is a common finding amongst elderly patients visiting spine surgeons for back pain. Uniportal unilateral laminotomy for bilateral decompression (ULBD) is an emerging minimally invasive procedure for lumbar canal stenosis. This study compared the clinical outcomes of endoscopic ULBD with Destandau technique and microscopic lumbar canal decompression.

**Methods:** A prospective multicenter study on 685 patients undergoing single-level spinal canal decompression. Patients with axial back pain, lumbar radiculopathy, lumbar canal stenosis & claudication distance < 1,000 m were included. Parameters assessed were Dura expansion, the central sac’s cross-sectional area, horizontal displacement, blood loss, operation time, hospital stay, modified MacNab score, visual analogue score (VAS), side changing (self) status, Oswestry Disability Index (ODI), and the Short-Form 36 for quality of life (QoL).

**Results:** Group 1 (endoscopic ULBD with Destandau technique) had 343 patients and group 2 (microscopic ULBD) had 342 patients. Group 1 had lower horizontal displacement (0.34% ± 0.21%, p < 0.001) and significant improvement of VAS (42.28% ± 3.20%, p < 0.001) at 1-week postsurgery with shorter hospital stay (1 ± 0.2 days vs. 1.8 ± 0.8 days, p < 0.01) and significant improvements of ODI and MacNab scores (42.28 ± 3.20 and 85.30%, p < 0.001). The 30-second chair test (3.4 ± 0.13 vs. 5.6 ± 2.41, p < 0.001), 10-meter walk test (1.0 ± 2.15 vs. 0.55 ± 3.23, p < 0.001), and SF-36 physical health component score (48.20 ± 8.46 vs. 74.48 ± 0.54, p < 0.001) improved significantly as well. Furthermore, 92% of patients were able to change sides while in bed at 1-week postsurgery. Claudication distance improved significantly in both groups.

**Conclusion:** Group 1 patients had better clinical and functional outcomes within 3 months of surgery than group 2 patients, with improved QoL, shorter hospital stays, claudication distance, and self-side changing ability.

**Key Words:** Spine, Endoscope, Laminotomy, Claudication, Stenosis, India
INTRODUCTION

Spinal canal stenosis remains the most common indication for spine surgery in elderly [1]. Patients with degenerated spine and neurological symptoms often have dysfunction [2], dissatisfaction and poor quality of life (QoL). Their output in daily routine activities suffer, rendering them dependent on others for assistance.

Patients with spinal canal stenosis often present with back pain and radiating pain. Treatment options range from medications to surgery. Recently minimal invasive techniques like unilateral laminotomy for bilateral decompression (ULBD) performed using endoscope system or microscope are being preferred [3]. The newer techniques involve use of enhanced optics, instrumentation, and artificial intelligence [4], thereby improving precision and limited tissue dissection. Research articles have reported early clinical recovery with endoscopic procedures, but studies comparing ULBD performed by with endoscopic system (Destandau technique) and microscope are very few.

Spine instability and back pain have been reported post microscopic ULBD [5]. Endoscopes on other hand offer excellent magnification, illumination and 4K clarity through a single portal. It is important to assess patient-related outcome scores to understand the impact of surgical procedure on patient's QoL.

This study was initiated to compare the clinical outcomes (surgical timing, blood loss, hospital stay, MacNab scores, Oswestry Disability Index (ODI), 36-item Short Form health survey [SF-36] scores, and complications) in patients undergoing spinal decompression performed by endoscope with Destandau technique and microscopes. Secondly to document patient specific parameters like visual analogue score (VAS), QoL, side changing ability postoperatively.

MATERIALS AND METHODS

A prospective multicenter study performed at 3 centers in Bhubaneswar, India from May 2012 to February 2019 on 685 patients undergoing single-level decompression for spinal canal stenosis. Patients were randomized into 2 groups; randomization was done by computer generated number.

1. Inclusion Criteria

Back pain, lumbar radiculopathy, lumbar canal stenosis (single level) with or without disc herniation, claudication distance <1,000 m, no improvement after 6 weeks conservative treatment and minimum 1-year follow-up.

2. Exclusion Criteria

Consent refusal, instability (segmental), same level surgery, extensive calcified or hard disc herniation, posterior longitudinal ligament ossification, and infection.

3. Surgical Technique

All procedures were performed under general anesthesia and standard radiolucent operating table was used for all surgeries.
1) **Group 1: modified chest knee position (Fig. 1)**

Destandau Endospine System (Karl Storz, Tuttingen, Germany) comprising of endospine tube, trocar, and working insert was used (Fig. 1). Levels were marked with use of localization device, skin incision (15–20 mm) was marked 5 mm besides midline, and Mayo scissors were used to dissect the aponeurosis. Periosteum elevator was used to dissect the paravertebral muscles from spinous process and superior lamellae to expose the interlaminar window. Laminotomy was performed under vision to expose underlying dural sac and nerve root. Discectomy was performed under vision (Fig. 2), adequacy was confirmed by pushing saline and visual confirmation by endoscope in disc cavity. Further, over-the-top decompression was performed on contralateral side (Fig. 3).

2) **Group 2: patient placed in Wilson Frame**

A 30- to 50-mm midline incision was marked. Aponeurosis along with paravertebral muscles were dissected as usual. Laminotomy was performed followed by the microscopic soft tissue decompression. Medial facet and ligamentum flavum were dissected under microscopic visualization by high-speed drill and a curette. Discectomy was performed followed by over-the-top decompression on contralateral side.

4. **Randomization and Blinding Protocol**

Patients were randomized into 2 groups. In group 1, ULBD were endoscope assisted, surgery performed with Destandau technique. In group 2, ULBD were microscope assisted.

The principal investigator was aware of the patient’s grouping and procedure done, did not perform the surgery or follow-up assessment himself. Surgeons performing the surgery did not know about the patient’s grouping. Doctors performing follow-up assessment were unaware of patient grouping and procedure performed.

5. **Parameters Assessed**

Authors assessed the dura expansion, thecal sac’s cross-sectional area, horizontal displacement, operation time, estimated...
blood loss, hospital stay, modified MacNab score, and incidence of complications in both groups.

6. Clinical Evaluation

Surgical scar condition, back pain status, radiating pain status, side changing (self) status and walking ability were assessed. VAS scores for back pain and leg pain, ODI, and SF-36 for the QoL were assessed.

7. Rehabilitation

Patients were offered bed rest depending on patient’s comfort. Active hip, knee, and ankle toe exercises (active and passive) were started on same day of surgery depending on patient’s tolerance. Weight bearing was allowed from day of surgery.

8. Follow-up

Patients were discharged 1–2 days after surgery. In both groups, patients were discharged 1–2 days after surgery. Patients were followed up during their visit to hospital at 1, 3, 6 weeks and 3, 6, 12 months postsurgery.

9. Statistical Analysis

IBM SPSS Statistics ver. 25.0 (IBM Co., Armonk, NY, USA) was used. Pre- and postoperative outcomes were compared by paired sample t-test. To compare clinical results between 2 groups; independent 2 sample t-test and chi-square test were used; p<0.001 was considered significant.

10. Ethical Statement

Ethical committee clearance was obtained before enrolling patients for the study (AH-2012/04-657). Written informed consents were obtained from all participants before the start of study.

RESULTS

A total of 685 patients who underwent single-level spinal canal ULBD were included in this study. Endoscopic ULBD with Destandau technique (group 1) had 343 patients and microscopic ULBD (group 2) had 342 patients. The demographic and preoperative characteristics of the patients were statistically similar (Table 1).

The radiologic outcomes and surgical data are shown in Table 2 and clinical outcomes are shown in Table 3. The degree

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### Table 1. Demographic and preoperative patient data

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group 1 (n = 343)</th>
<th>Group 2 (n = 342)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>62.45 ± 4.14</td>
<td>61.56 ± 5.08</td>
<td>0.24</td>
</tr>
<tr>
<td>Sex, male:female</td>
<td>183 (53.3):160 (46.6)</td>
<td>179 (52.4):163 (47.6)</td>
<td>0.09</td>
</tr>
<tr>
<td>Symptom duration (wk)</td>
<td>14.10 ± 3.48</td>
<td>13.80 ± 2.90</td>
<td>0.72</td>
</tr>
<tr>
<td>Level treated</td>
<td></td>
<td></td>
<td>0.65</td>
</tr>
<tr>
<td>L2/3</td>
<td>21 (6.1)</td>
<td>18 (5.26)</td>
<td></td>
</tr>
<tr>
<td>L3/4</td>
<td>82 (23.9)</td>
<td>86 (25.1)</td>
<td></td>
</tr>
<tr>
<td>L4/5</td>
<td>118 (34.4)</td>
<td>121(35.3)</td>
<td></td>
</tr>
<tr>
<td>L5/S1</td>
<td>122 (35.5)</td>
<td>117 (34.2)</td>
<td></td>
</tr>
<tr>
<td>Symptom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low back pain</td>
<td>85 (24.7)</td>
<td>77 (22.4)</td>
<td>0.87</td>
</tr>
<tr>
<td>Radiculopathy</td>
<td>168 (48.9)</td>
<td>172 (50.2)</td>
<td>0.32</td>
</tr>
<tr>
<td>Both</td>
<td>90 (26.2)</td>
<td>94 (27.4)</td>
<td>0.48</td>
</tr>
<tr>
<td>Disc herniation</td>
<td>322 (93.8)</td>
<td>319 (93.2)</td>
<td>0.23</td>
</tr>
<tr>
<td>Cross-sectional area (mm²) of thecal sac (preoperative)</td>
<td>368.24 ± 75.46</td>
<td>372.72 ± 89.34</td>
<td>0.28</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation or number (%).
Group 1, endoscopic ULBD with Destandau technique; group 2, microscopic ULBD; ULBD, unilateral laminotomy for bilateral decompression.

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of horizontal displacement was lower in group 1 than group 2 (0.34±0.21% vs. 2.45±1.61%, p<0.001). Postoperative pain and ODI expressed in percentage were significantly improved in both groups (p<0.001). There was a significant difference in the improvement of pain (VAS) at 1 week after operation between the groups 1 and 2 (42.28±3.20% vs. 50.15±6.82%, p<0.001). Authors observed a significant difference in hospital stay. Group 1 patients were comfortable and discharged early (1±0.2 vs. 1.8±0.8, p<0.01).

There was a significant difference in ODI at 1 week after operation between the groups 1 and 2 (42.28±3.20 vs. 50.15±6.82, p<0.001). However, there was no significant difference in ODI at 1 month after operation and 1 year after operation in both groups.

There was a significant difference in the modified MacNab score at 1 week after operation between the groups 1 and 2 (85.30% vs. 88.44%, p<0.001). However, the difference was not significant from 1-month to 1-year postsurgery.

There was no significant difference in dura expansion (336.61±58.32 vs. 318.10±64.72, p=0.21), operation time (59.20±8.14 vs. 68.45±12.07, p=0.04) and blood loss the groups 1 and 2 (52.42±9.82 vs. 60.32±14.20, p=0.02).

At 1-week postsurgery; there was significant improvement in the 30-second chair test results (3.4±0.13 vs 5.6±2.41, p<0.001) and 10-meter walk test (1.0±2.15 vs 0.55±3.23, p<0.001) (Table 4) values in group 1. SF-36 physical health component subscale score also had significant improvement at 1-week postsurgery in group 1 (48.20±8.46 vs. 74.48±5.4, p<0.001). Furthermore, 92% of patients were able to change sides while in bed at 1-week postsurgery. Overall QoL and patient satisfaction was better in group 1. Claudication distance improved significantly after decompression for both the groups (Table 4).

There were 22 cases (6.43%) of cerebrospinal fluid leak in group 2 and 12 (3.50%) cases in group 1, all of which were treated with conservative treatment including bed rest, fluid replacement, and medications. Surgical site infection occurred in 8 cases (2.3%) in group 2 and 5 (1.45%) in group 1, all of which were treated with antibiotics. At 1-year follow-up, 6 patients (1.74%) in group 1 and 11 patients (3.21%) in group 2 had recurrence.

**DISCUSSION**

There is often a poor radiographical and clinical correlation in spine pathologies. The treatment must be tailored to accom-

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**Table 3.** Comparison of clinical outcomes between endoscopic decompression and microscopic decompression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual analogue scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td>8.02±0.64</td>
<td>7.95±0.64</td>
<td>0.43</td>
</tr>
<tr>
<td>Postoperative (1 wk)</td>
<td>2.42±0.72</td>
<td>3.80±0.24</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative (1 mo)</td>
<td>1.82±0.52</td>
<td>2.20±0.32</td>
<td>0.21</td>
</tr>
<tr>
<td>Postoperative (3 mo)</td>
<td>1.47±0.43</td>
<td>1.64±0.62</td>
<td>0.43</td>
</tr>
<tr>
<td>Postoperative (1 yr)</td>
<td>1.14±0.36</td>
<td>1.20±0.42</td>
<td>0.74</td>
</tr>
<tr>
<td>Oswestry Disability Index (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td>74.40±3.18</td>
<td>73.80±5.78</td>
<td>0.62</td>
</tr>
<tr>
<td>Postoperative (1 wk)</td>
<td>42.28±3.20</td>
<td>50.15±6.82</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative (1 mo)</td>
<td>31.20±2.21</td>
<td>36.20±4.82</td>
<td>0.88</td>
</tr>
<tr>
<td>Postoperative (3 mo)</td>
<td>24.18±3.20</td>
<td>27.38±4.15</td>
<td>0.72</td>
</tr>
<tr>
<td>Postoperative (1 yr)</td>
<td>16.42±2.10</td>
<td>20.70±3.22</td>
<td>0.28</td>
</tr>
<tr>
<td>Modified MacNab score (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postoperative (1 wk)</td>
<td>85.3</td>
<td>88.44</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative (1 mo)</td>
<td>78.33</td>
<td>81.46</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative (3 mo)</td>
<td>72.8</td>
<td>77.86</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative (1 yr)</td>
<td>68.63</td>
<td>71.4</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation.
Group 1, endoscopic ULBD with Destandau technique; group 2, microscopic ULBD; ULBD, unilateral laminotomy for bilateral decompression.

**Table 4.** Functional outcomes between groups 1 and 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperatively</td>
<td>Postoperatively</td>
<td></td>
</tr>
<tr>
<td>30s Chair stand test</td>
<td>3.4±0.13</td>
<td>5.6±2.41</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>10MWT (min)</td>
<td>1.0±2.15</td>
<td>0.55±3.23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SF-36 PHCSS</td>
<td>48.20±8.46</td>
<td>74.48±5.04</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SF-36 MHCSS</td>
<td>42.34±6.50</td>
<td>72.25±9.30</td>
<td>0.05</td>
</tr>
<tr>
<td>Side changing – self (%)</td>
<td>30.23</td>
<td>92.65</td>
<td>-</td>
</tr>
<tr>
<td>Claudication distance (km)</td>
<td>0.72±0.14</td>
<td>3.1±0.6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation unless otherwise indicated.
Group 1, endoscopic ULBD with Destandau technique; group 2, microscopic ULBD; ULBD, unilateral laminotomy for bilateral decompression; 30s chair test, 30-second chair test; 10MWT, 10-m walk test; SF-36, 36-item Short Form health survey; PHCSS, physical health component subscale score; MHCSS, mental health component subscale score.*Clinical assessment at 1-week postsurgery.
modate patient’s needs. Patients not responding to conserva-
tive therapy warrant surgical decompression [6]. Minimally in-
vasive surgical procedures are being done for patients suffering
from lumbar canal stenosis worldwide [7].

Conventional or open decompressive laminectomy has been
done over the years and is an established procedure. Although
it offers better hand control and manipulative freedom; but it
involves extensive soft tissue stripping and larger surgical scar.
Conventional surgical management of lumbar canal stenosis
has been open decompressive laminectomy. This is a useful
procedure with enhanced hand manipulative control, but it
involves stripping and retraction of paraspinal muscles along
with removal of spinal process and lamina, this can lead to
iatrogenic instability [8], adhesions [9], scarring and para spinal
muscle atrophy thus persistent back pain.

Minimal invasive techniques aim at precise dissection and
specific soft tissue removal, limiting removal of important
structures. This allows early rehabilitation, better clinical
outcomes [10] and cosmesis. Variety of surgeries are being
performed using minimally invasive techniques like lumbar
discectomy [11], foraminal decompression, spinal fusion, and
deformity correction [12]. The patients underwent surgery with
minimally invasive techniques. The advantages of minimally
invasive approach undergo minimal tissue trauma, blood loss,
shorter operative time, lesser hospital stays, perineural fibrosis
[13,14], and have less analgesic requirement postoperatively.

Endoscopic spinal instrumentation has revolutionized spine
surgeries. It offers clear magnified 4K vision, illumination, and
magnification with precise soft tissue removal. Learning curve
is high in endoscopic surgery due to small working channel
and space, which can improve with training and experience.

In our study, patients presented with back pain, radiating
pain, and combination of both. Group 1 patients had a shorter
hospital stay, less blood loss, and operative time. They also had
significantly better VAS scores and ODI at 1 week postoper-
atively. Later, scores were still better for group 1 but were not
statistically significant between the 2 groups.

Significantly improved modified MacNab scores were ob-
erved in group 1 at 1-week, 1-month, and 3-month follow-ups
(Table 3). At 1 year postoperatively, these scores were better for
endoscopic group but not statistically significant.

At 1 week postoperatively, group 1 patients tolerated surgical
procedure better and had improved functional scores (30-sec-
ond chair stand test and 10-meter walk test) postoperatively
with better SF-36 scores; the physical health component results
were statistically significant (Table 4). However, the statistical
difference between the 2 procedures was not significant in SF-
36 mental health component scores.

Postoperatively; 92.65% patients could change side by them-
selves in group 1 as compared to 87.72% in group 2. These
results could be interpreted as a significant improvement in
the QoL of patients in group 1 at 1-week postsurgery. Improved
claudication distance was seen in both the groups postsurgery
owing to effective decompression.

CONCLUSION

Group 1 patients have better clinical and functional out-
comes within 3 months of surgery compared to group 2 pa-
tients. They have improved QoL with shorter hospital stays,
better SF-36 scores and self-side changing ability.

NOTES

Conflicts of Interest

The authors have nothing to disclose.

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ORCID

Paresh Chandra Dey https://orcid.org/0000-0003-1842-4445
Nishit Palo https://orcid.org/0000-0002-9439-3313
Abhishek Shukla https://orcid.org/0009-0007-2472-6331

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