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Original Article

Early Postoperative Recovery and Hospital Stay Following Endoscopic Lumbar Spine Surgery: A Prospective Observational Study

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ABSTRACT

Background: Full-endoscopic lumbar surgery is a minimally invasive option for disc herniation and stenosis, but early-recovery data from Bangladesh are limited. **Objectives:** To describe early postoperative recovery and length of hospital stay after endoscopic lumbar spine surgery. **Methods & Materials:** This prospective observational study enrolled 30 consecutive adults who underwent single-level full-endoscopic interlaminar lumbar surgery at two private tertiary-care hospitals in Dhaka. Time to standing and walking, medical fitness and discharge, leg and back pain (visual analogue scale, VAS) and adverse events up to day 30 were recorded. **Results:** Mean age was 38.8 ± 11.6 years; 23 (76.7%) had disc herniation and 7 (23.3%) stenosis. Mean operative time was 69.0 ± 13.4 minutes, with no conversion or dural tear; 2 patients (6.7%) had transient dysaesthesia and 1 (3.3%) a port-site infection. Patients walked at 4.1 ± 0.1 hours and were fit for discharge at 4.9 ± 0.2 hours. Mean postoperative stay was 14.2 ± 2.0 hours; all patients went home within 24 hours, 29 (96.7%) on the day of surgery. Leg pain VAS fell from 7.6 ± 0.5 to 4.2 ± 0.8 at discharge and 2.6 ± 0.5 at 24 hours, and back pain from 6.2 ± 0.8 to 3.2 ± 0.4 (both $p < 0.001$). At day 30, 28 patients (93.3%) rated the outcome as satisfactory. **Conclusion:** Endoscopic lumbar spine surgery allowed walking about 4 hours and discharge within 24 hours after surgery, with rapid relief of leg pain, few complications and high satisfaction at 30 days.

Keywords: *Endoscopic spine surgery; Lumbar disc herniation; Lumbar stenosis; Length of stay; Early ambulation*

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INTRODUCTION

Prolapsed lumbar intervertebral disc (PLID) and degenerative lumbar stenosis are among the commonest causes of low back pain and sciatica in adults, and they carry a large burden of lost work days. Since Mixter and Barr first linked disc rupture to radicular symptoms, surgical removal of the herniated fragment has been the definitive treatment when conservative care fails[1]. Randomised evidence shows that surgery gives faster relief of leg pain and disability than continued non-operative care in selected patients[2]. Open discectomy and, later, microdiscectomy became the standard procedures, but both require paraspinal muscle retraction and partial removal of lamina and ligamentum flavum.

Full-endoscopic lumbar surgery was developed to reach the disc and the spinal canal through an 8–10 mm working channel under continuous saline irrigation. The transforaminal approach was popularised by Yeung and Tsou[3], and the interlaminar approach by Ruetten and colleagues[4] and by Choi and colleagues for the L5–S1 level[5]. A randomised trial showed clinical results equal to microsurgery, with less traumatisation and faster rehabilitation[6]. A large multicentre non-inferiority trial later found less blood loss, a shorter admission and earlier mobilisation after endoscopic discectomy, with better leg pain scores at 12 months[7]. Several meta-analyses support lower blood loss, fewer wound complications and an earlier return to work[8–11].

The benefit most relevant to patients and hospitals is a short and predictable recovery. Day-surgery series report discharge within 6–8 hours[12,13], and enhanced-recovery pathways have shortened stay further[14]. Early ambulation appears safe[15]. Yet most studies measure outcomes from 4–6 weeks onward and describe discharge only as "early", without its exact timing[13]. Length of stay also varies widely between health systems, from hours to several days[14,16,17].

In Bangladesh, endoscopic spine surgery is now offered in public and private centres. Published studies from Bangladesh and the region have mainly compared endoscopic with open discectomy, focusing on complications and final outcome[18–20]. There are few prospective data on the hour-by-hour early recovery course and the actual length of stay in private-sector practice. This study therefore aimed to describe early postoperative recovery — time to standing and walking, pain and complications — and length of hospital stay after endoscopic lumbar spine surgery, with follow-up to 30 days.

METHODS & MATERIALS

STUDY DESIGN AND SETTING

This prospective observational study was conducted in the Departments of Orthopaedics of two private tertiary-care hospitals in Dhaka, Bangladesh: MiCare Specialized Hospital, Shyamoli, and AURORA Specialized Hospital, Kakrail. The same surgical team, technique, postoperative protocol and discharge criteria were used at both hospitals. The study ran from July 2025 to June 2026. The study is reported according to the STROBE statement for observational studies[21].

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ETHICAL APPROVAL AND CONSENT

The protocol was approved by the Ethical Review Committee of MiCare and AURORA Specialized Hospital, Kakrail. All patients gave written informed consent. Identifiable data were stored in secure clinical records, and the analysis dataset used study identification numbers only.

PATIENTS

All consecutive adults who underwent full-endoscopic lumbar surgery during the study period and met the eligibility criteria were enrolled; 30 patients were included. No formal sample-size calculation was performed.

Inclusion criteria: age 18 years or older; single-level lumbar disc herniation, lumbar stenosis or both on MRI, concordant with radicular leg pain or neurogenic claudication; failure of at least 6 weeks of conservative treatment, or progressive or disabling neurological deficit; consent to follow-up.

Exclusion criteria: segmental instability or spondylolisthesis requiring fusion; previous surgery at the index level; cauda equina syndrome; infection, tumour or fracture; multilevel disease.

PREOPERATIVE ASSESSMENT

Demographic data, body mass index (BMI), diagnosis, operated level and side of symptoms were recorded on a structured two-page data sheet. Leg and back pain were measured on a 0–10 visual analogue scale (VAS).

SURGICAL TECHNIQUE

All operations were performed by the senior surgeon under general or spinal anaesthesia using a full-endoscopic system (RIWOspine; Richard Wolf GmbH, Knittlingen, Germany). The endoscope had an outer diameter of 8.4 mm, an intra-endoscopic working channel of 5.7 mm and a 12° viewing angle. Patients were positioned prone on a radiolucent frame, and the level was confirmed with fluoroscopy. All procedures used the interlaminar approach, following the techniques of Ruetten et al. and Choi et al.[4–6]. Under continuous saline irrigation, the herniated fragment was removed with endoscopic forceps and, where stenosis was present, the ligamentum flavum and lateral recess were decompressed with endoscopic drills and Kerrison punches until the traversing nerve root was free. Bipolar radiofrequency was used for haemostasis, and the skin was closed with a single suture. Any conversion to open or microscopic surgery was recorded. A representative case is shown in *Figure 1*.

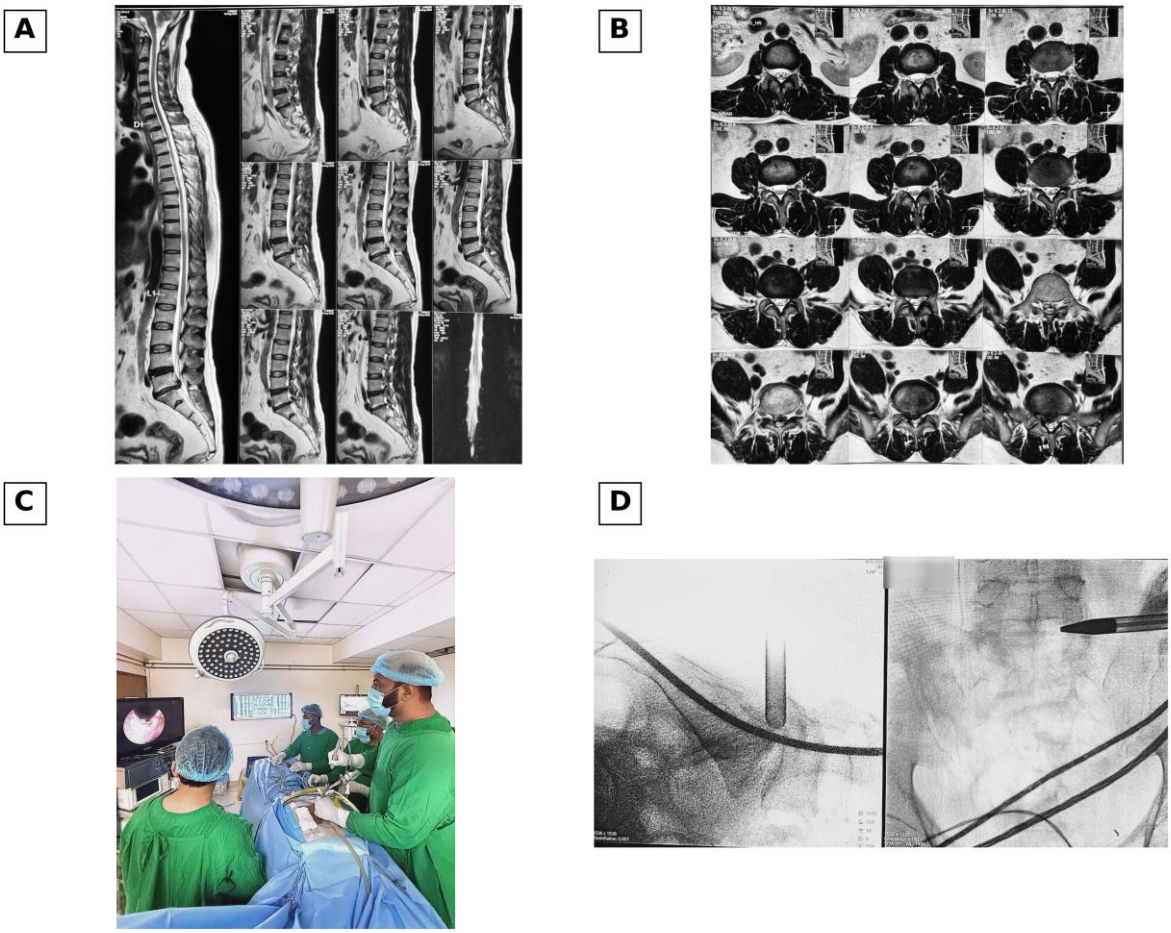

Figure 1: Representative case. (A) Preoperative sagittal T2-weighted MRI showing lumbar disc herniation; (B) axial T2-weighted MRI showing paracentral disc herniation compressing the traversing nerve root; (C) intraoperative set-up for full-endoscopic interlaminar lumbar surgery, with the endoscopic view on the monitor; (D) intraoperative fluoroscopy (lateral and anteroposterior views) confirming the position of the working cannula. Patient identifiers have been removed from the images.

POSTOPERATIVE CARE AND DISCHARGE CRITERIA

Patients received oral analgesics, with intravenous analgesics added when needed. They were encouraged to stand and walk as soon as the anaesthetic effect had worn off, with nursing assistance at the first attempt. The date and time of first standing and first independent walking were recorded. Patients were considered fit for discharge when they could walk independently, had leg pain controlled by oral analgesics, voided normally, had a dry wound and no new neurological deficit. The time of medical fitness and the actual discharge time were both recorded, and the reason for any delay was noted.

FOLLOW-UP AND OUTCOME MEASURES

Patients were assessed in hospital and contacted at day 30 by telephone or clinic visit. Patient flow through the study and the assessment schedule are shown in *Figure 2*.

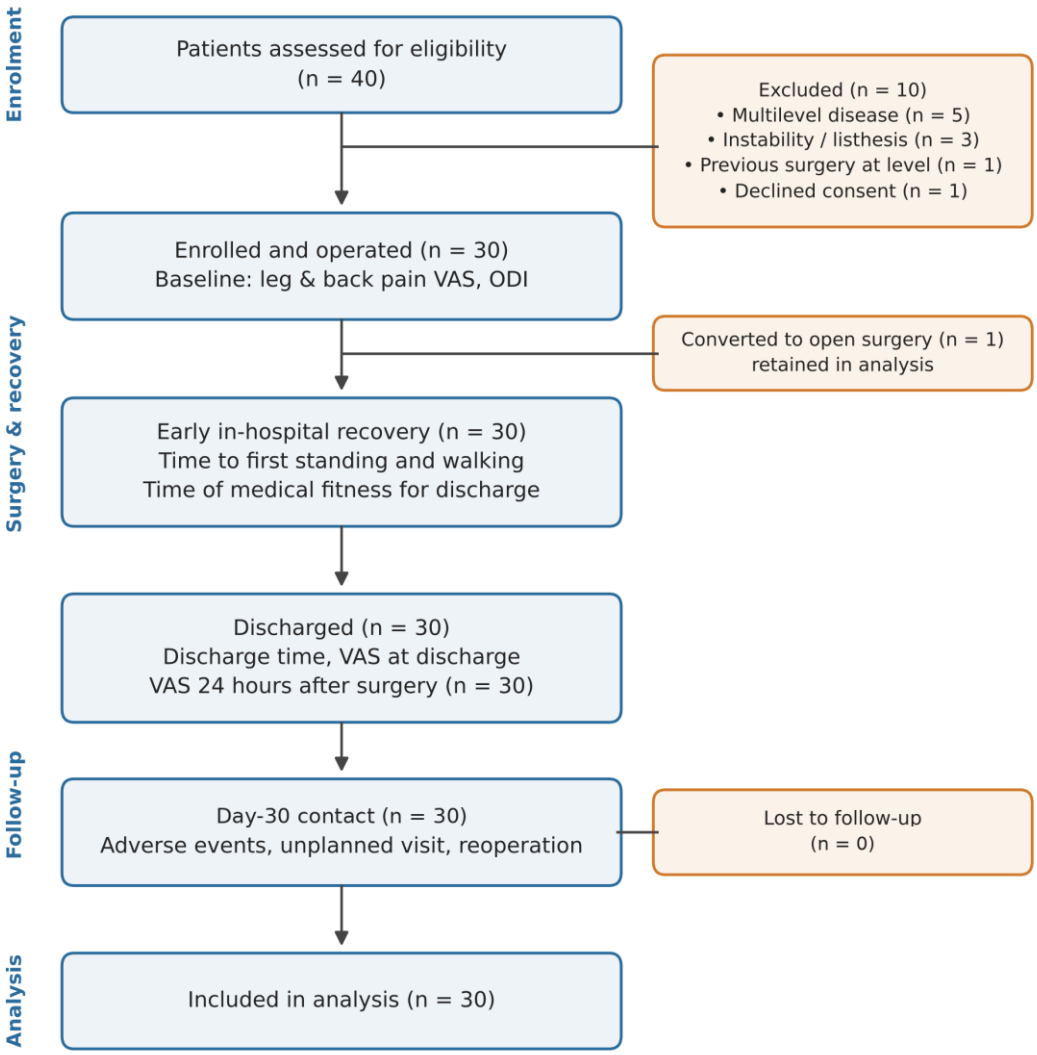

Figure 2: Patient flow and assessment schedule, following the STROBE recommendations.

Primary outcome: postoperative hospital stay, in hours from the end of surgery to discharge.

Secondary outcomes: total hospital stay (admission to discharge); time to first standing and walking; time to medical fitness for discharge and the gap to actual discharge; leg and back pain VAS before surgery, at discharge and 24 hours after surgery; operative time; estimated blood loss; perioperative adverse events (dural tear, haematoma, new deficit, dysaesthesia, infection, urinary retention, anaesthesia events); unplanned visit, readmission or reoperation within 30 days; and patient-rated satisfactory outcome at day 30, defined as "excellent" or "good" on the modified Macnab criteria. The 24-hour pain score was recorded on the ward for patients still in hospital and by telephone for those already discharged; as all 30 patients had been discharged by 24 hours, every 24-hour score was in practice obtained by telephone. The modified Macnab criteria grade outcome as excellent (no pain, no restriction of activity), good (occasional pain, no significant restriction), fair (some improvement but persistent pain or activity limitation) or poor (no improvement or worse).

STATISTICAL ANALYSIS

Data were analysed with SPSS version 26.0. Normality was checked with the Shapiro–Wilk test. Continuous variables are reported as mean ± standard deviation (SD) or median (interquartile range, IQR), and categorical variables as number (percentage). Change in VAS across the three time points was tested with repeated-measures ANOVA or the Friedman test, as appropriate, and each postoperative value was compared with baseline using the paired t-test or Wilcoxon signed-rank test; the mean change from baseline to 24 hours is given with its 95% confidence interval (CI). A p-value below 0.05 was considered significant. Tables give the full numerical results; figures are used where they add information: the patient flow (flow diagram), the categorical profile of the cohort (bar chart), the spread of recovery times (box plots) and the course of pain over time (line graph with error bars).

RESULTS

PATIENT CHARACTERISTICS

Of 40 patients assessed for eligibility, 10 were excluded (multilevel disease 5, instability or listhesis 3, previous surgery at the index level 1, declined consent 1) and 30 were enrolled (20 at MiCare and 10 at AURORA). All 30 underwent endoscopic lumbar surgery and were discharged, and 30 were reached at day 30 (*Figure 2*). The mean age was 38.8 ± 11.6 years (range 25–55). The largest age group was 41–50 years (14 patients, 46.7%), followed by 40 years or younger (9, 30.0%) and over 50 years (7, 23.3%). There were 19 men (63.3%) and 11 women (36.7%), a male-to-female ratio of 1.7:1, and the mean body mass index was 24.3 ± 3.9 kg/m². Twenty-three patients (76.7%) had lumbar disc herniation and 7 (23.3%) had lumbar stenosis. Symptoms were left-sided in 17 patients (56.7%), right-sided in 8 (26.7%) and bilateral in 5 (16.7%). The operated level was L4–L5 in

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15 patients (50.0%), L5–S1 in 9 (30.0%), L3–L4 in 4 (13.3%) and L2–L3 in 2 (6.7%). Before surgery, mean leg pain VAS was 7.6 ± 0.5 and back pain VAS 6.2 ± 0.8. Baseline characteristics are given in *Table I*, and the categorical profile of the cohort is summarised in *Figure 3*.

Table I

Baseline characteristics of the patients (*n* = 30).

Characteristic	Value
Age, years, mean ± SD (range)	38.8 ± 11.6 (25–55)
Age ≤40 / 41–50 / >50 years, n (%)	9 (30.0) / 14 (46.7) / 7 (23.3)
Sex: male / female, n (%)	19 (63.3) / 11 (36.7)
Body mass index, kg/m², mean ± SD	24.3 ± 3.9
Diagnosis: disc herniation / stenosis, n (%)	23 (76.7) / 7 (23.3)
Side of symptoms: left / right / bilateral, n (%)	17 (56.7) / 8 (26.7) / 5 (16.7)
Operated level: L4–L5 / L5–S1 / L3–L4 / L2–L3, n (%)	15 (50.0) / 9 (30.0) / 4 (13.3) / 2 (6.7)
Preoperative leg pain VAS, mean ± SD	7.6 ± 0.5
Preoperative back pain VAS, mean ± SD	6.2 ± 0.8

VAS, visual analogue scale (0–10).

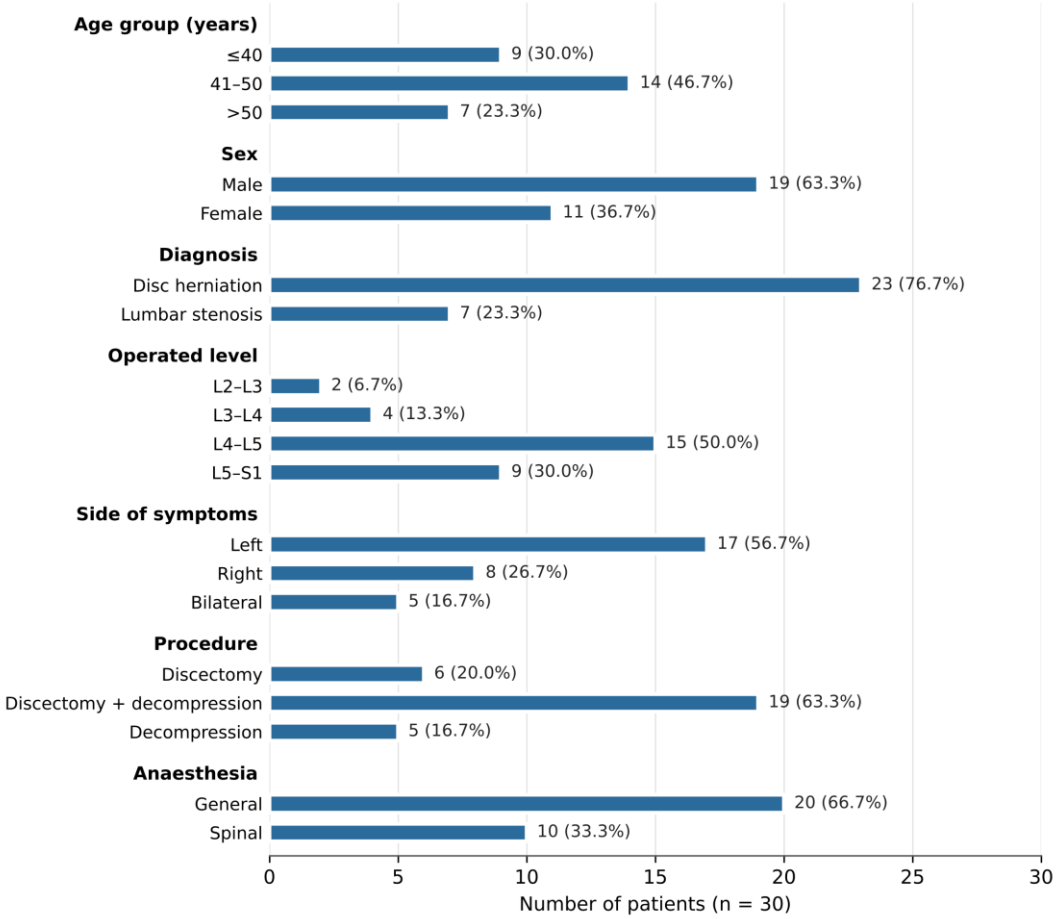

Figure 3: Demographic, clinical and operative profile of the patients (n = 30). Bars show the number of patients; labels give n (%).

OPERATIVE DATA

All 30 operations were single-level and used the interlaminar approach. Discectomy alone was done in 6 patients (20.0%), discectomy with decompression in 19 (63.3%), and decompression alone in 5 (16.7%). Twenty patients (66.7%) had general anaesthesia and 10 (33.3%) spinal anaesthesia (*Figure 3*). Mean operative time was 69.0 ± 13.4 minutes (range 60–90), and estimated blood loss was approximately 30 mL in every patient. No operation required conversion to open surgery, and no intraoperative dural tear occurred (*Table II*).

Table II

Operative data (*n* = 30).

Variable	Value
Approach: interlaminar / transforaminal, n (%)	30 (100) / 0
Procedure: discectomy / discectomy + decompression / decompression, n (%)	6 (20.0) / 19 (63.3) / 5 (16.7)
Levels operated per patient	1 (all)
Anaesthesia: general / spinal, n (%)	20 (66.7) / 10 (33.3)
Operative time, minutes, mean ± SD (range)	69.0 ± 13.4 (60–90)
Estimated blood loss, mL	≈30 in all patients
Conversion to open/microscopic surgery, n (%)	0

Variable	Value
Intraoperative adverse event, n (%)	0

EARLY RECOVERY AND HOSPITAL STAY

Patients first stood and walked at a mean of 4.1 ± 0.1 hours after the end of surgery (median 4.0, range 4.0–4.25). They were judged medically fit for discharge at 4.9 ± 0.2 hours. The mean postoperative stay was 14.2 ± 2.0 hours (median 15.0, IQR 13.5–15.5) and the mean total stay 21.2 ± 3.0 hours. All 30 patients went home within 24 hours of surgery, 29 (96.7%) on the day of surgery (**Table III**). Actual discharge followed medical fitness by a mean of 9.3 hours. This delay was organisational rather than clinical, reflecting the timing of the consultant's discharge round, completion of discharge paperwork and take-home medication, the availability of an escort or transport home, and, in one case, the patient's preference to stay until the following morning. No patient's discharge was delayed for a medical reason. *Figure 4* shows the spread of each recovery milestone.

Table III

Early recovery and length of hospital stay (*n* = 30)

Outcome	Mean ± SD	Median (IQR)	Range
Time to first standing and walking, hours	4.1 ± 0.1	4.0 (4.0–4.0)	4.0–4.25
Fit for discharge after surgery, hours	4.9 ± 0.2	5.0 (4.75–5.0)	4.5–5.0
Gap from fitness to actual discharge, hours	9.3*	—	—
Postoperative stay (surgery end to discharge), hours	14.2 ± 2.0	15.0 (13.5–15.5)	11.0–16.0
Total stay (admission to discharge), hours	21.2 ± 3.0	22.0 (18.0–24.0)	18.0–24.0
Discharged within 24 h of surgery, n (%)	30 (100)	—	—
Discharged on the day of surgery, n (%)	29 (96.7)	—	—

**Difference between the mean postoperative stay and the mean time to medical fitness for discharge, both measured from the end of surgery.*

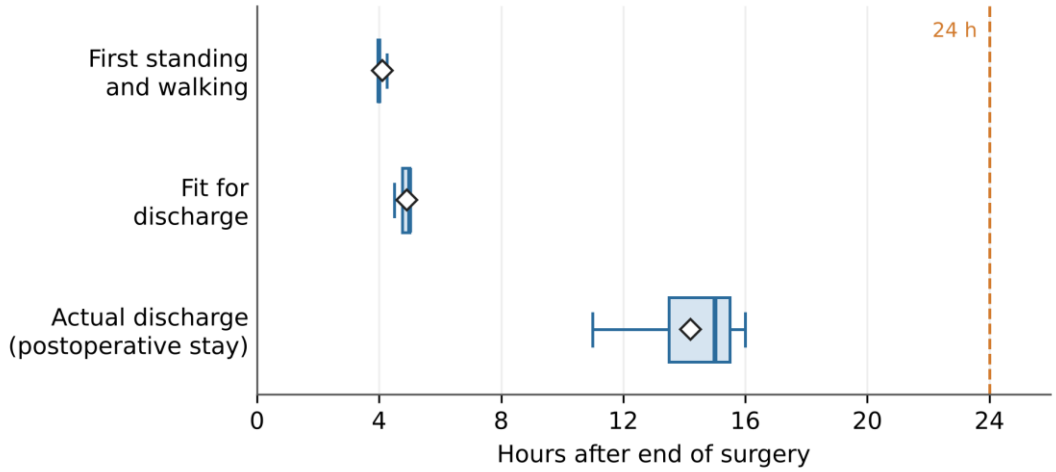

Figure 4: Time from the end of surgery to each recovery milestone (n = 30). Boxes show the median and IQR, whiskers the range and diamonds the mean, drawn from the summary statistics in Table III. The dashed line marks 24 hours.

PAIN OUTCOME

Leg pain VAS fell from 7.6 ± 0.5 before surgery to 4.2 ± 0.8 at discharge and 2.6 ± 0.5 at 24 hours after surgery, a mean reduction of 5.0 points by 24 hours (95% CI 4.63 to 5.37; p < 0.001). Back pain VAS fell from 6.2 ± 0.8 to 4.0 ± 1.0 at discharge and 3.2 ± 0.4 at 24 hours, a mean reduction of 3.0 points (95% CI 2.55 to 3.45; p < 0.001) (*Table IV*; *Figure 5*). Both scores were already significantly lower than baseline at discharge (p < 0.001).

Table IV

Pain over time (*n* = 30).

Time point	Leg pain VAS, mean ± SD	Back pain VAS, mean ± SD
Preoperative	7.6 ± 0.5	6.2 ± 0.8
Discharge	4.2 ± 0.8	4.0 ± 1.0
24 hours after surgery	2.6 ± 0.5	3.2 ± 0.4
Mean change, baseline to 24 hours (95% CI)	−5.0 (−5.37 to −4.63)	−3.0 (−3.45 to −2.55)
p-value versus baseline	< 0.001‡	< 0.001‡

‡ Paired t-test against baseline, both at discharge and at 24 hours. Rows are in chronological order: all patients had been discharged before the 24-hour assessment.

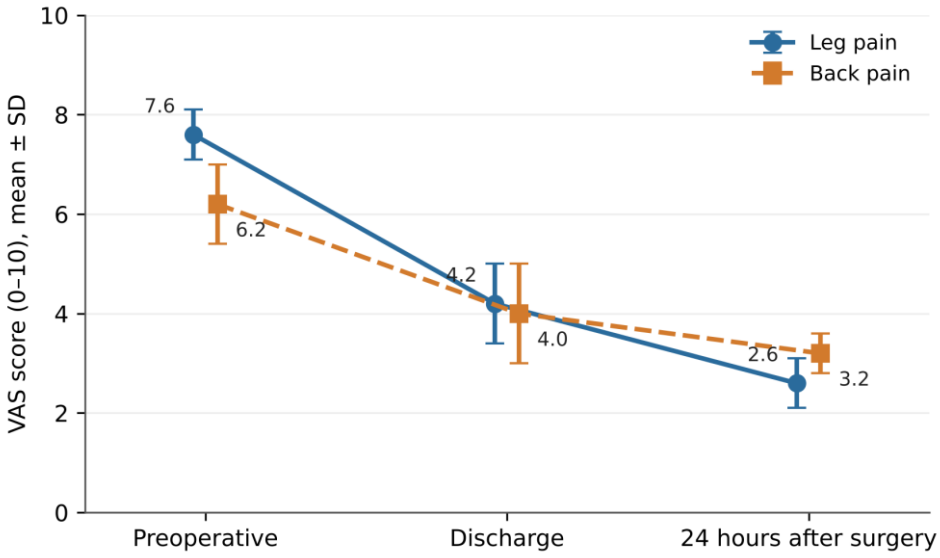

Figure 5: Leg and back pain VAS before surgery, at discharge and 24 hours after surgery (mean ± SD, *n* = 30).

COMPLICATIONS AND 30-DAY OUTCOME

Adverse events up to day 30 are listed in *Table V*. Three postoperative adverse events were recorded. Transient dysaesthesia occurred in 2 patients (6.7%); it was treated with pregabalin and methylcobalamin and resolved within 12 weeks. A port-site infection occurred in 1 patient (3.3%) and healed with oral antibiotics and dressing, without debridement. No dural tear or cerebrospinal fluid leak, haematoma, new neurological deficit or urinary retention occurred. No operation was converted to open surgery (*Table II*), no patient returned to theatre before discharge, and none required reoperation for recurrence or a residual fragment within 30 days. At the day-30 contact, 28 patients (93.3%) rated the outcome as satisfactory.

Table V
Adverse events up to day 30 (*n* = 30).

Event	n (%)	Management
Dural tear / CSF leak	0	—
Transient dysaesthesia	2 (6.7)	Pregabalin and methylcobalamin; resolved within 12 weeks
Haematoma	0	—
New neurological deficit	0	—
Urinary retention	0	—
Port site infection	1 (3.3)	Oral antibiotics and dressing; healed without debridement
Return to theatre before discharge	0	—
Reoperation (recurrence or residual fragment)	0	—

DISCUSSION

In this prospective series of 30 adults treated with full-endoscopic interlaminar lumbar surgery, patients stood and walked about 4 hours after surgery and left hospital a mean of 14.2 hours after surgery; all were discharged within 24 hours. Leg pain fell by 5 points within 24 hours, two had transient dysaesthesia and one a port-site infection, there was no conversion to open surgery or dural tear, and 93.3% were satisfied at 30 days. These findings support endoscopic surgery as a procedure that can shorten the in-hospital phase of recovery in our setting.

DEMOGRAPHIC PROFILE

The mean age of 38.8 years, with nearly half of patients aged 41–50 years, reflects a working-age population, and the inclusion of 7 patients (23.3%) with stenosis, a degenerative condition of later life, contributed to the older age groups. The male predominance (63.3%) closely matches a Bangladeshi series from Rangpur, which had 62% men overall and 64% in its endoscopic group[19], and a recent meta-analysis of endoscopic discectomy patients[22]. Left-sided symptoms predominated (56.7%), and bilateral symptoms (16.7%) were consistent with central herniation or stenosis. L4–L5 was the commonest level (50.0%), followed by L5–S1 (30.0%), close to the 52% and 36% in the endoscopic group of the Rangpur series[19]; the National Institute of Neurosciences study enrolled L4–L5 cases only[18]. Six of our patients (20.0%) were operated at L3–L4 or L2–L3, upper levels where the interlaminar window is narrower.

MOBILISATION & HOSPITAL STAY

Early ambulation is a central element of enhanced recovery after spine surgery. In our series, patients stood and walked at a mean of 4.1 hours and were medically fit for discharge at 4.9 hours. Yu et al. showed that full-endoscopic discectomy can be done as day surgery with walking soon after surgery and an 8-hour stay, without worse clinical results or more revisions[12], and Aprile et al. discharged all 32 of their patients within 6 hours[13]. In the randomised trial of Gadjradj et al., all endoscopic patients were mobilised and 94% were discharged on the day of surgery[7]. Our postoperative stay of 14.2 hours is close to the 12 hours reported by Choi et al. with the same interlaminar approach[5], longer than these day-surgery series, which used local anaesthesia, and much shorter than the 1.4 days of the day-surgery pathway of Kou et al.[14] and the 2.3 days reported from Rangpur[19]. All our patients received general or spinal anaesthesia, which probably added some hours to recovery. Qin et al. examined whether the timing of first ambulation after endoscopic discectomy affects recurrence[15]. Patients were medically fit for discharge less than 5 hours after surgery but stayed a further 9.3 hours on average, for

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organisational reasons such as the timing of the consultant's round, discharge paperwork and transport home. This suggests that hospital routine, rather than clinical recovery, set the final length of stay, and that a nurse-led discharge against fixed criteria could bring the stay close to that of day-surgery series.

COMPARISON WITH CONVENTIONAL SURGERY

We did not include a control group, but the literature allows indirect comparison. The randomised trial by Gadjradj et al. found a shorter admission and earlier mobilisation with endoscopic discectomy than with open microdiscectomy[7]. Meta-analyses have found a shorter stay with endoscopic discectomy, by a mean of about 2.4 days in one analysis[11], although a 2026 meta-analysis restricted to randomised trials found length of stay similar between the two techniques[10]. This difference likely reflects variation in discharge practice between countries more than in the procedure itself. A large registry analysis also found lower adverse-event rates and shorter stays after endoscopic than open discectomy[17]. Bangladeshi and Pakistani comparative studies reported a shorter stay, less blood loss and earlier return to work with endoscopy[19,20], and a Dhaka study found few complications after endoscopic discectomy[18].

PAIN

Leg pain fell from 7.6 to 4.2 at discharge and 2.6 at 24 hours, showing that decompression of the nerve root relieved radicular pain almost at once and that relief continued after the patients went home. Back pain improved from 6.2 to 3.2, consistent with the limited muscle damage of the endoscopic approach. Kou et al. found a similar immediate fall in leg pain, from 6.7 to 0.8, after endoscopic discectomy under local anaesthesia[14]. The 93.3% satisfaction at 30 days is close to the 90.8% favourable outcome reported by Choi et al. with the same approach[5]. Ruetten et al. reported equivalent long-term clinical results with endoscopic and microsurgical discectomy[6], and a randomised meta-analysis found slightly better back pain at one year with endoscopy[10]. Aprile et al. noted that most studies start evaluation at 4–6 weeks and miss the early phase[13]; our hour-by-hour recording adds data on this period.

COMPLICATIONS AND SAFETY

No operation in our series required conversion to open surgery, whereas Choi et al. reported a 3% conversion rate (2 of 67) with the same interlaminar approach[5]. Likewise, no dural tear occurred, compared with 2 in that series. The only postoperative adverse events were transient dysaesthesia in 2 patients (6.7%), which resolved with medical treatment within 12 weeks, and a port-site infection in 1 (3.3%), which healed without debridement; none required reoperation. Pooled randomised data show that endoscopic surgery lowers postoperative infection, poor wound healing and haematoma, although it increases radiation exposure[10]. Dural tear and transient dysaesthesia are the most frequently reported complications of endoscopic discectomy[5]. In a series of 235 day-surgery endoscopic discectomies, Cao et al. likewise found dysaesthesia to be the main complication, attributed mainly to heat from radiofrequency coagulation, and their patients recovered gradually over about 3 months of oral mecobalamin or other conservative treatment[23]; this course matches the resolution within 12 weeks in our two patients, and as bipolar radiofrequency was also used for haemostasis in our technique, careful, low-power coagulation near the nerve root may help to reduce it. A French cohort showed good outcomes during the learning curve, with operative time falling as experience grew[16], which is relevant to centres in Bangladesh where the technique is still being adopted; our mean operative time of 69 minutes was almost identical to the 68 minutes reported from Rangpur[19].

CLINICAL IMPLICATIONS

With every patient discharged within 24 hours of surgery, endoscopic lumbar surgery could be planned as a short-stay or day-case procedure in suitable patients in Bangladesh, reducing bed occupancy and indirect costs for patients who lose work days. Standard discharge criteria and the structured data sheet used in this study are simple to adopt.

LIMITATIONS

This was a two-centre study with a modest sample and no formal sample-size calculation, so the estimates are imprecise and rare complications may have been missed. There was no control group, so comparisons with open or microscopic surgery are indirect. Pain was not measured beyond 24 hours, so functional recovery over 30 days could not be assessed; day-30 contact recorded adverse events and patient satisfaction only. The series mixes disc herniation and stenosis, and the results may reflect the experience of one surgical team and the discharge practice of two private hospitals in Dhaka, which limits generalisation to public-sector or other settings.

CONCLUSION

Full-endoscopic interlaminar lumbar surgery allowed patients to walk about 4 hours after surgery and to be discharged a mean of 14.2 hours after surgery, all within 24 hours, with a marked reduction in leg pain within 24 hours, few complications and 93.3% patient satisfaction at 30 days. The procedure appears suitable for short-stay pathways in Bangladesh. Larger comparative studies with longer functional follow-up are recommended.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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