

## Safety of Interlaminar Full-Endoscopic Lumbar Decompression

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### Abstract

In this review of the safety of endoscopic lumbar decompression surgery via the interlaminar window, we evaluate two parameters to elucidate the safety of this approach, complication rate and radiation exposure. The most common surgery-related complication is dural tear, as opposed to exiting nerve root injury via the transforaminal approach. The incidence of dural injury is similar to that of traditional lumbar surgery. There is a learning curve for this surgery, and the complication rate decreases after gaining experience in 100 cases. In terms of radiation exposure, interlaminar full-endoscopic surgery has shorter fluoroscopic time than transforaminal full-endoscopic surgery. Overall, full-endoscopic interlaminar surgery is regarded as a safe procedure, but special care should be taken to prevent dural injury.

**Keywords:** Full-Endoscopic Spine Surgery; Decompression Surgery; Interlaminar Approach; Complication

### Introduction

Full-endoscopic spine surgery (FESS) was initially performed via the transforaminal approach and was subsequently followed by the introduction of the interlaminar approach. Historically, the procedure was called selective endoscopic surgery [1,2] or percutaneous endoscopic surgery [3,4]; as of 2020, a multinational consensus has recommended the term “full-endoscopic surgery” [5]. Endoscopic surgeons treat a variety of the spinal conditions using these two approaches. Initially, the indications for FESS were limited to removal of herniated nucleus pulposus [1-3]. However, with the evolution of surgical instruments such as surgical drills and bone rongeurs, decompression for spinal canal stenosis has become possible [4]. This FESS approach is new though and, compared with traditional open surgery, it may be associated with unique surgery-related complications. In this article, we review the safety of interlaminar FESS.

### Safety of the interlaminar approach for discectomy

#### Complications of the approach for discectomy

Basically, full-endoscopic discectomy is recommended via the transforaminal approach [6,7]. In cases at the L5-S1 level, when the height of the iliac crest is large, the interlaminar approach is recommended [8,9].

Wasinpongwanich, *et al.* [10] reviewed 545 cases following interlaminar full-endoscopic discectomy. Clinical outcomes were favorable. In relation to surgical safety, the reported intraoperative complications of nerve root injury (n = 3) and dural tear (n = 1). Further-

more, postoperative complications included numbness ( $n = 18$ ), weakness ( $n = 5$ ), and residual disc fragment ( $n = 1$ ), with no infection or hematoma reported. They thus concluded that interlaminar full-endoscopic discectomy would be a safe and effective surgery. Kong, *et al.* [11] analyzed 98 cases of L5-S1 interlaminar discectomy. Among them, 87 (92.6%) showed excellent or good clinical outcomes. In terms of surgery-related complications, only 1 dural tear and 1 nerve root damage were reported. They therefore concluded that this surgical procedure was safe and effective. In a review of 67 cases experienced, Choi, *et al.* reached a similar conclusion [12].

Xie, *et al.* [13] analyzed the learning curve of the procedure for interlaminar full-endoscopic discectomy in a total of 482 cases. They found 29 (6.0%) procedure-related complications. The complication rate in the initial 100 cases was 18% and this decreased to 2.9% after 100 cases. Their report suggests that the safety of this surgery can be reliably achieved by skillful surgeons after having performed about 100 of these procedures.

### Comparison with the transforaminal approach

Chen, *et al.* [14] reviewed the interlaminar and transforaminal approaches at L5-S1 in 9 studies involving 621 patients and found no significant differences between the two approaches in clinical outcomes at 1 day postoperatively, 3 months postoperatively, or at last follow-up. There were also no significant differences found in surgery-related complications; however, dural tear was more common in the interlaminar approach.

In a meta-analysis [15], Huang, *et al.* compared the safety and effectiveness of transforaminal versus interlaminar full-endoscopic discectomy. Their analysis included 13 trials (974 cases) consisting of 3 randomized controlled trials, 3 prospective studies, and 7 retrospective studies. Clinical outcomes with reference to the Macnab criteria and visual analog scale score at final follow-up were not significantly different between the two approaches. Regarding complications, analysis with fixed-effect models revealed more complications with the interlaminar approach than with the transforaminal approach. A major advantage of the former was the shorter operative time and lower intraoperative blood loss.

### Safety of interlaminar decompression for lumbar canal stenosis

In a meta-analysis by Lee, *et al.* [16] of 5 retrospective cohort studies, complication rates were not substantially high but particular complications were evident, such as transient paresthesia in 2.6% of cases, incidental durotomy in 3.2% and hematoma in 1.9%. Mc-Garth, *et al.* [17] reported surgery-related complications during bilateral interlaminar decompression in 50 cases to be 8.0% overall.

Lee, *et al.* [18] reviewed 223 cases of interlaminar decompression for spinal canal stenosis. They divided the patients into two groups: group 1 comprised the initial 100 cases and group 2 the next 100 to 223 cases. There was an obvious learning curve in relation to operative time and complication rate. Operative times decreased from 105.26 min to 67.65 min from group 1 to group 2. Likewise, surgery-related complications decreased, with the learning curve dropping from 16% to 8.3%. This suggests that the learning curve is an important safety consideration.

Unlike for transforaminal surgery, interlaminar decompression for lumbar canal stenosis is most commonly complicated by dural injury. However, dural injury is still rare and exiting nerve root injury (ENRI) is more common with the transforaminal approach. Sairyo, *et al.* [19] reported 2 incidents of ENRI (2.0%) among their initial 100 cases; Choi, *et al.* reported 20 (8.9%) among 233 cases [20].

Muller, *et al.* [21] reviewed 12 studies in the literature with reference to dural injury during interlaminar endoscopic surgery. The mean rate of dural injury was 2.7% and range from 0% to 8.6%. Dural injury was more common during decompression surgery for spinal canal stenosis than during discectomy (3.7% vs 2.1%, respectively). They concluded that dural tear is the most frequent complication of bilateral decompression surgery and care must therefore be taken during the surgery to avoid injury to the dura mater.

Kim, *et al.* [22] reviewed dural injury in their 330 consecutive cases of interlaminar endoscopic decompression surgery. They encountered 27 cases (8.2%) of dural injury. Endoscopic patch placement was successful in 26 cases, with open conversion and repair was required in 1 case where the tear size was over 1 cm. Regarding the surgical lumbar spine level of the dural injury, 40.7% were confirmed to be at L3-4, 44.4% at L4-5 and 14.8% at L5-S1. In traditional open lumbar surgery for degenerative disc disease, dural injury was reported in 7.6% of 2,024 primary cases and 15.9% of 1,159 revision cases [23]. Thus, the incidence of dural injury during both endoscopic and open surgery is likely similar.

Several reports have described low complication rates, however. A series by Birjandian, *et al.* [24] found no surgery-related complications, although their sample size was small ( $n = 10$ ). Huang, *et al.* [25] reviewed their 106 consecutive cases of bilateral full-endoscopic decompression for lumbar canal stenosis and found very few complications, namely, 1 case of durotomy, 1 of open revision surgery, and 2 of delayed surgical site infection.

### Safety for patient and surgeon in terms of radiation exposure

Ahn, *et al.* [26] evaluated the radiation dose to which 3 spinal surgeons were exposed while performing 30 consecutive percutaneous endoscopic lumbar discectomy (PELD) procedures (33 levels) during a 3-month period. Occupational exposure of the surgeon was higher during full-endoscopic surgery than during conventional surgery. Without radiation shielding, a surgeon performing 291 PELDs annually would be exposed to the maximum allowable radiation dose. Thus, it is important to consider the fluoroscopy time during surgery and to shorten it as much as possible.

A meta-analysis by Huang, *et al.* [15] also reviewed the intraoperative fluoroscopy time in 9 papers involving 310 transforaminal and 331 interlaminar cases. They found significant differences between the two surgical approaches, including shorter fluoroscopy time with the interlaminar approach. Thus, interlaminar surgery may be safer for surgeons and patients in terms of radiation exposure. Also, Li, *et al.* [27] measured C-arm X ray radiation time during transforaminal and interlaminar lateral recess decompression surgery and reported this as 7.5 s and 0.5 s, respectively. As such, the interlaminar approach is much safer than the transforaminal approach for both surgeon and patient.

### Conclusion

In this review article, we have examined the safety of the interlaminar approach for FESS, focusing on the safety of this approach in comparison with transforaminal FESS and traditional open interlaminar surgery. We conclude that interlaminar full-endoscopic surgery would be a safe procedure with reference to surgery-related complications and radiation exposure, but special care should be taken to avoid dural injury.

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