

Endoscopic versus microscopic discectomy for pathologies of lumbar spine: A nationwide cross-sectional study from a lower-middle-income country

ABSTRACT

Objective: We conducted a cross-sectional study to assess the preference of spine surgeons between MD for microdiscectomy and endoscopic discectomy (ED) surgery for the management of lumbar pathologies in a lower-middle-income country (LMIC).

Methodology: An online survey assessing the preference of spine surgeons for various lumbar pathologies was developed and disseminated in "Neurosurgery Cocktail" a social media platform. Statistical analyses were performed using SPSS software with a level of significance <0.05.

Results: We received responses from 160 spine surgeons having a median experience of 6.75 years (range 0–42 years) after residency. Most of the spine surgeons preferred MD over ED, preference being homogeneous across all lumbar pathologies. In ED, the interlaminar approach was preferred more frequently than the transforaminal approach. The most commonly chosen contraindication for the interlaminar approach and transforaminal approach was 3 levels lumbar disc herniation (LDH) ($n = 117, 73.1\%$) and calcified LDH ($n = 102, 63.8\%$), respectively. There was no significant association between the type of approach preferred (MD vs. ED; and interlaminar vs. transforaminal endoscopic approach) with the type of workplace and the level of experience.

Conclusion: Spine surgeons were inclined toward MD over ED, due to various reasons, such as a steep learning curve, lack of training opportunities, and upfront expenses. There is a pressing need for the upliftment of ED in LMICs which requires global action.

Keywords: Interlaminar endoscopic surgery, lumbar disc, microdiscectomy, transforaminal endoscopic surgery

INTRODUCTION

With advancements in spine surgery, the focus has now shifted to minimally invasive spine surgeries (MISS) which are being preferred over traditional open spine surgeries owing to a smaller incision and other benefits including less trauma, reduced blood loss, rapid recovery, decreased hospital stay, and lower risk of hospital-acquired infections.^[1,2] There are many forms of MISS, two of which have been extensively utilized by spine surgeons in their daily practice, namely, microscopic and endoscopic techniques which implicate the use of an instrument, either a microscope or an endoscope, respectively. These approaches provide better visualization as well as decreased perioperative complications.^[2]

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Microscopic discectomy was introduced in 1990 by Williams^[3] and since then, it has gained popularity by facilitating minimal muscle disruption and gentle manipulation of the dura/nerve roots.^[2] While it has made a mark due to the decreased opioid use, reduced healthcare costs, and faster recovery; studies have reported increased dural tear rates and incomplete symptomatic relief.^[4,5] Endoscopic discectomy (ED) has significantly reduced the surgical field to a corridor of 10 mm² as well as minimized the paraspinous muscle cutting to almost zero. Interlaminar and transforaminal are the two major approaches under the endoscopic technique of which interlaminar has been found to be superior to transforaminal since it allows access to central and paracentral disc herniations.^[6]

Although ED has had equivalent outcomes with less intense postoperative pain as compared to MD,^[7] however, its use is limited in the lower-middle-income countries (LMICs) due to the requirement of trained personnel, and higher costs of instruments and installation. Nevertheless, it is imperative to understand the perspective of the surgeons toward the utilization of MD and ED in their practice. Therefore, through this study, we aim at evaluating the preference of spine surgeons between MD and ED in an Indian setup for the management of lumbar pathologies.

METHODOLOGY

Study design

We conducted a cross-sectional survey-based study wherein a descriptive, 17-item, nonrandomized online survey, was created using Google Forms. The survey was designed adhering to the Checklist for Reporting Results of Internet E-Surveys guidelines for e-surveys and was tested by three spine surgeons before circulating its final form. Responses were collected between November 2022 and January 2023. Surveys were shared with spine surgeons through E-mail and “Neurosurgery Cocktail” social media platforms including Facebook, Twitter, Telegram, LinkedIn, and WhatsApp groups. No educational or financial incentives were provided to the participants and participation was voluntary. Informed consent was taken from all respondents in the survey.

Survey content [Table 1]

The survey consisted of four parts. The first part recorded the demographics of the respondents, the second part consisted of questions related to the choice between MD and ED for various lumbar spine conditions, the third part comprised of questions related to choice between interlaminar and transforaminal ED approach, and the fourth part focused on the opinions of respondents on the contraindications of MD and ED.

Statistical analysis

Data were converted into an Excel and the statistical analysis of the data was performed using SPSS software version 26.0 IBM, New Orchard Road Armonk, New York 10504-1722, United States. Chi-square test was applied, wherever relevant. The threshold of 10 years was used to categorize spine surgeons into less and more experienced for statistical purposes. A $P < 0.05$ was considered statistically significant.

RESULTS

We received a total of 160 responses, with a mean experience of 9.2 years and median experience of 6.75 years (range 0–42 years) after residency. Fifty-eight (36.3%) respondents were working in a government setup, 54 (33.8%) in a private setup, and 48 (30%) respondents in both [Figure 1].

Microscopic versus endoscopic approach

MD was preferred over ED by the spine surgeons for all lumbar spine pathologies, assessed in the study, including single-level lumbar disc herniation (LDH) with unilateral symptoms (69% vs. 26%), migrated LDH (76% vs. 20.6%), axillary type LDH (66.3% vs. 28.2%), single-level LDH with bilateral symptoms (78.1% vs. 5%), multi-level LDH with unilateral symptoms (74.4% vs. 13.2%), multi-level LDH with bilateral symptoms (72.5% vs. 10.7%), lumbar canal stenosis (63.8% vs. 10%), recurrent LDH (60% vs. 11.9%), and calcified LDH (64.4% vs. 8.8%). *The type of approach was not associated with the type of workplace, and the level of experience for the lumbar spine pathologies assessed in the study [Table 1].*

Interlaminar versus transforaminal endoscopic approach

Interlaminar was preferred over transforaminal endoscopic approach by the spine surgeons for all lumbar spine pathologies, assessed in the study, including single-level LDH with unilateral symptoms (22% vs. 4%), migrated LDH (17.5% vs. 3.1%), axillary type LDH (16.9% vs. 11.3%), single-level LDH with bilateral symptoms (4.4% vs. 0.6%), multi-level LDH with

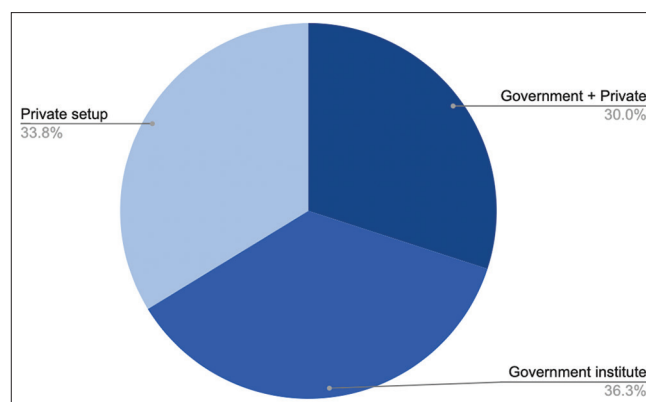


Figure 1: Type of workplace of the included spine surgeons

Table 1: Demographics of the included spine surgeons, their preference for the type of approach (microscopic vs. endoscopic) for various spine diseases, and its association with the type of workplace and the level of experience

Parameter	Frequency, <i>n</i> (%)	<i>P</i> (type of workplace)	<i>P</i> (level of experience)
Years of practice after residency	0–42 years	0.928	-
Mean	9.2 years		
Median	6.75 years		
Workplace			
Government	58	-	0.653
Private	54		
Both	48		
Single-level lumbar discectomy with unilateral symptoms			
Endoscopic	41 (26)	0.131	0.209
Microscopic	111 (69)		
No preference	8 (5)		
Single-level-migrated lumbar disc			
Endoscopic	33 (20.6)	0.115	0.103
Microscopic	122 (76)		
No preference	5 (3.1)		
Single-level axillary type of lumbar disc herniation			
Endoscopic	45 (28.2)	0.871	0.069
Microscopic	106 (66.3)		
No preference	9 (5.6)		
Single-level lumbar discectomy with bilateral symptoms			
Endoscopic	24 (5)	0.766	0.275
Microscopic	125 (78.1)		
No preference	11 (6.9)		
Multi-level lumbar discectomy with unilateral symptoms			
Endoscopic	21 (13.2)	0.867	0.502
Microscopic	119 (74.4)		
No preference	20 (12.5)		
Multi-level lumbar discectomy with bilateral symptoms			
Endoscopic	17 (10.7)	0.744	0.232
Microscopic	116 (72.5)		
No preference	27 (16.9)		
Lumbar canal stenosis			
Endoscopic	16 (10)	0.349	0.178
Microscopic	102 (63.8)		
No preference	42 (26.3)		
Recurrent disc herniation			
Endoscopic	19 (11.9)	0.119	0.110
Microscopic	96 (60)		
No preference	45 (28.1)		
Calcified lumbar disc herniation			
Endoscopic	14 (8.8)	0.128	0.110
Microscopic	103 (64.4)		
No preference	43 (26.9)		

unilateral symptoms (9.4% vs. 3.8%), multi-level LDH with bilateral symptoms (8.8% vs. 1.9%), lumbar canal stenosis (9.4% vs. 0.6%), small neural foraminal height (38% vs. 30%), thick spinous process (37.5% vs. 20.6%), facet hypertrophy (37.5% vs. 18.1%), recurrent LDH (9.4% vs. 2.5%), and calcified LDH (6.9% vs. 1.9%). The type of endoscopic technique was not associated with the type of workplace, and the level of experience for the lumbar spine pathologies assessed in the study [Table 2].

Contraindications for interlaminar and transforaminal endoscopic approaches

The contraindications for the interlaminar approach were three or more level LDH ($n = 117$, 73.1%), unstable spine ($n = 106$, 66.3%), hypertrophic facets ($n = 80$, 50%), and thick spinous process ($n = 52$, 32.5%). One of the participants (0.6%) did not regard any of the aforementioned conditions contraindication for interlaminar approach.

Table 2: Preference of the spine surgeons for the type of endoscopic approach for various spine diseases and its association with the type of workplace and the level of experience)

Parameter	Frequency, <i>n</i> (%)	<i>P</i> (type of workplace)	<i>P</i> (level of experience)
Single-level lumbar discectomy with unilateral symptoms			
Interlaminar	35 (22)	0.517	0.735
Transforaminal	6 (4)		
Single-level-migrated lumbar disc			
Interlaminar	28 (17.5)	0.156	0.909
Transforaminal	5 (3.1)		
Single-level axillary type of lumbar disc herniation			
Interlaminar	27 (16.9)	0.719	0.761
Transforaminal	18 (11.3)		
Single-level lumbar discectomy with bilateral symptoms			
Interlaminar	23 (4.4)	0.331	0.600
Transforaminal	1 (0.6)		
Multi-level lumbar discectomy with unilateral symptoms			
Interlaminar	15 (9.4)	0.416	0.517
Transforaminal	6 (3.8)		
Multi-level lumbar discectomy with bilateral symptoms			
Interlaminar	14 (8.8)	0.292	0.377
Transforaminal	3 (1.9)		
Lumbar canal stenosis		0.377	0.696
Interlaminar	15 (9.4)		
Transforaminal	1 (0.6)		
Small neural foraminal height*		0.783	0.440
Interlaminar	61 (38)		
Transforaminal	48 (30)		
Not applicable	51 (32)		
Thick spinous process*			
Interlaminar	60 (37.5)	0.552	0.213
Transforaminal	33 (20.6)		
Not applicable	67 (41.9)		
Facet hypertrophy*			
Interlaminar	60 (37.5)	0.545	0.151
Transforaminal	29 (18.1)		
Not applicable	71 (44.4)		
Recurrent disc herniation			
Interlaminar	15 (9.4)	0.913	0.570
Transforaminal	4 (2.5%)		
Calcified lumbar disc herniation			
Interlaminar	11 (6.9)	0.429	0.308
Transforaminal	3 (1.9)		

*The preference between microscopic and endoscopic approach was not assessed for these conditions

The contraindications for transforaminal approach were calcified LDH ($n = 102$, 63.8%), associated lumbar canal stenosis ($n = 94$, 63.8%), recurrent disc ($n = 79$, 49.4%), small neural foraminal height ($n = 64$, 40%), L5-S1 level LDH ($n = 55$, 34.4%), axillary type disc herniation ($n = 49$, 30.6%), and others [$n = 13$, 8.1%, Table 3].

DISCUSSION

The standard of care for most lumbar spine disc pathologies is MD. In MD, a working channel is created using a retractor (either tubular or X-shaped) and a microscope

is positioned over it, hemi or total laminectomy is done, ligamentum flavum is incised and excised, the nerve root is retracted medially and the herniated disc tissue is resected. The procedural complications include nerve root injury, new or worsening neurological injury, hematoma, wound complications, recurrence, and reoperation. MD is significantly superior from open spine discectomy, owing to a lesser invasion, in terms of back pain (Odds ratio = 0.66, 95% confidence interval = 0.44–0.99, $P < 0.05$), operating time (mean 72.2 min vs. 93.5 min), estimated blood loss (37.9 mL vs. open 76.8), duration of hospital stay (73% vs. 40% same-day discharge), rates of incidental

Table 3: Contraindications for interlaminar and transforaminal endoscopic approach

What do you think may be contraindications for*	Number of responses, n (%)
Endoscopic interlaminar approach	
3 or more level lumbar disc herniation	117 (3.1)
Unstable spine	106 (6.3)
Hypertrophic facets	80 (50)
Thick spinous process	52 (32.5)
None	1 (0.6)
Endoscopic transforaminal approach	
Calcified lumbar disc herniation	102 (3.8)
Associated lumbar canal stenosis	94 (58.8)
Recurrent disc	79 (49.4)
Small neural foraminal height	64 (40)
L5-S1 disc level	55 (34.4)
Axillary type of disc	49 (30.6)
Others	13 (8.1)

*More than one contraindication could be chosen for an approach

durotomy (4% vs. 8%), and wound-related complications (3% vs. 9%).^[8] The horizon of MISS broadened with the introduction of ED.^[9] In the transforaminal endoscopic approach, the discectomy and decompression are performed through intervertebral foramen between exiting and traversing nerve roots, while in the interlaminar approach, the trajectory of the working cannula is placed more sagittally, medial to the facet joint. The complications include neurovascular injury, peritoneal sac perforation, missed fragments, wrong level exploration, instrument damage, psoas hematoma, infection, cerebrospinal fluid cyst formation, recurrence, and instability.

Single-level lumbar discectomy

For the surgical management of single-level lumbar discectomy, ED is minimally invasive, while the standard surgical approach is MD.^[9] The majority of the spine surgeons preferred MD over ED (unilateral symptoms: 69% vs. 26%; bilateral symptoms: 78.1% vs. 5%) in our study because ED restricts the usage of both hands which makes it difficult to control bleeding and significantly increases the duration of operation (difficult learning curve) ($P = 0.002$).^[9,10] For patients with bilateral symptoms, even higher percentage of spine surgeons preferred MD over ED, possibly because a higher level of skill is required to decompress the contralateral nerve root in patients with bilateral symptoms. Furthermore, ED for LDH management is conceptually similar to arthroscopic surgeries, which may bias the responses of orthopedicians toward ED. Hence, further studies need to evaluate the responses of neurosurgeons and orthopedicians separately. Although the ideal indications for transforaminal and interlaminar are different, transforaminal technique offers better pain relief, and functional recovery in selected patients but with more operation time and a higher fluorescence exposure. However,

a higher number of the spine surgeons preferred interlaminar over transforaminal technique (unilateral symptoms: 22% vs. 4%; bilateral symptoms: 4.4% vs. 0.6%), most likely because the transforaminal technique requires more complicated puncture technique and fluorescence guidance for accurate surgical trajectory with a more rigid working window, primarily at L5-S1 level with high iliac crest and narrow intervertebral space.^[11-13] Other reason could be that a higher radiation exposure, in the absence of radiation shielding, may have precluded surgeons to perform transforaminal ED.^[11,14] Furthermore, the posterior approach of interlaminar techniques is similar to open surgical techniques which makes the identification of endoscopic vision easier.

Single-level-migrated lumbar disc

With the advancement of instrumentation, percutaneous endoscopic lumbar discectomy is increasingly being applied to manage patients. However, higher number of the spine surgeons preferred MD over ED (76% vs. 20.6%), which could partially be attributed to a decreased risk of missing disc fragments and increased experience with MD.^[15] Nearly six times, the spine surgeons preferred interlaminar versus transforaminal endoscopic approach (17.5% vs. 3%), possibly because a complete resection of highly down-migrated disc material is more difficult with transforaminal approach, which may lead to poor pain outcome.

Single-level axillary type of lumbar disc herniation

For the management of single-level axillary disc herniation, a higher proportion of spine surgeons preferred MD over ED (66.3% vs. 28.2%). It can be attributed to the fact that ED is more technically demanding than MD. Slightly higher percentage of spine surgeons preferred interlaminar approach over the transforaminal approach (16.9% vs. 11.3%) to manage axillary-type disc herniation, which may also be due to the transforaminal approach being newer.

Multi-level lumbar discectomy

It is challenging to choose the type of surgical technique to manage multilevel LDH which can provide nerve decompression and functional spine recovery with minimal spine instability. Both approaches significantly improved pain and provided functional recovery,^[16-18] however, nearly three-fourth of the spine surgeons preferred MD over ED (unilateral symptoms: 74.4% vs. 13.2%; bilateral symptoms: 72.5% vs. 10.7%), probably because of presumed inadequate exposure in ED. In ED, more spine surgeons preferred interlaminar approach over transforaminal approach (unilateral symptoms: 9.4% vs. 3.8%; bilateral symptoms: 8.8% vs. 1.9%), however, the underlying reason could not be elucidated. Hence, more research is needed in this area.

Lumbar canal stenosis

MD is considered the routine approach for MISS for lumbar canal stenosis.^[19] However, the utilization of MD to manage lumbar canal stenosis has fewer limitations, such as difficult instrumentation, probable insufficient decompression, and longer operation time, which can be overcome, to some extent, by biportal endoscopic spinal surgery.^[19,20] Nevertheless, the 63.8% spine surgeons preferred to use MD over ED, probably, because of, the theoretical risk to exiting nerves, steep learning curve, and limited ability to extend ED in cases of unexpected hindrances, as mentioned by one of the participants, “MD allows to carry out more of what may be additionally required.”^[21] Among the spine surgeons preferring ED over MD, almost all of them chose interlaminar over transforaminal approach because structures exerting posterior compression over the spinal cord cannot be accessed with the latter in patients with lumbar canal stenosis.^[22]

Small neural foraminal height, facet hypertrophy, thick spinous process

For patients with small neural foraminal height and facet hypertrophy, the spine surgeons preferred interlaminar over the transforaminal approach because small neural foraminal height may obstruct the trajectory of the endoscope in transforaminal approach.^[23] We suspect that a thick spinous process may preclude the trajectory of the working cannula in interlaminar approach, still a higher number of spine surgeons preferred interlaminar over transforaminal approach, which requires further studies to investigate for the underlying cause.

Recurrent disc herniations

In patients with recurrent disc herniation, the risk of injury to dura and nerves increases due to the epidural scarring, hence minimally invasive approaches, that is, MD and ED approaches are associated with better patient outcome.^[24-26] Although the clinical results are similar with both the techniques, ED is significantly superior in terms of complications, rehabilitation and traumatization, owing to the ability to circumvent epidural scarring due to previous surgery.^[27] Nevertheless, nearly five times the number of spine surgeons preferred MD over ED (60% vs. 11.9%). The underlying reason may be more familiarity with the use of microscope. For ED, transforaminal approach is generally recommended over interlaminar approach because of a lesser risk of injury to nerve adhered to scar tissue. However, the indications of transforaminal approach are limited to bulging, subligamentous or transligamentous extruded disc herniation at disc level located L4/L5 or higher,^[28-30] which may be responsible for a higher fraction of the spine surgeons preferring interlaminar approach over transforaminal approach (9.4% vs. 2.5%).

Calcified herniated lumbar disc

Calcification complicates the surgical management of herniated lumbar disc and is associated with a higher incidence of iatrogenic nerve root injury. Kim *et al.*^[26] managed 31 patients of calcified LDH (cLDH) with ED and reported postoperative sensory change, transient mild motor weakness and recurrence in 6.5%, 3.2%, and 3.2% patients, respectively, during a mean follow-up duration of 26.5 months. Wang *et al.*^[31] managed 37 cLDH patients with open microsurgical foraminal decompression procedure without resection of the herniated discs and found a lower incidence of postsurgical complication at an average follow-up period of 1 year, which likely explains the higher proportion of the spine surgeons preferring MD over ED (64.4% vs. 8.8%). In ED, interlaminar and transforaminal approaches have comparable outcomes with the former taking lesser operation time and fluorescence exposure ($P < 0.0001$), and tedious handling of endoscope makes resection of herniated calcified disc difficult, which might be responsible for a higher fraction of the spine surgeons opting interlaminar approach more than transforaminal approach (6.9% vs. 1.9%).^[31]

Scope of minimally invasive lumbar surgery in lower-middle-income countries

Globally, the trend toward usage of ED is not replicated well in the LMICs as compared to high-income countries,^[32] which can be attributed to a lack of availability of expensive instrumentation. However, we found a comparable preference profile of the spine surgeons in government and public settings, indicating that economic support is not the sole determinant of poor adoption of endoscopic LDH surgery in LMICs. Recent economic studies have shown that ED has a significantly lesser direct and indirect cost as compared to MD ($P < 0.01$), owing to several variables such as cost associated with surgery (operation, surgical equipment, radiology, anesthesia, hospital stay, laboratory work, nursing care, use of patient-controlled anesthesia, and medication/physical therapy), postoperative care cost, and cost incurred by work loss.^[32,33] The results should be interpreted with caution because a lesser experienced endoscopic spine surgeons may have a worse patient outcome with a higher complication rate, which may inflate the cost of ED. Other determinants for the same could be a deficiency of trained personnel and training opportunities such as hands-on cadaver or synthetic model training workshops, in-person observerships, and proctorships.^[34,35] To start with, digital teaching with neurosurgical training institutions should be promoted,^[36] and twinning programs could be adopted wherein a facility in a high-income country is coupled with one in an LMIC to ameliorate the access to collaborative training and research opportunities.^[37,38] The high cost of endoscopes can be tackled, to some extent, with multi-disciplinary

collaborations to develop economically suitable endoscopes for training, if not for treating, as done for affordable laparoscopic camera system by Gheza *et al.*^[39] In future, the possibility of using Metaverse for training purpose, especially for challenging cases, could also be explored. With the upcoming innovations in ED, there is a need to continuously update instruments and personnel.^[39] In addition, there is a requirement of standardized multi-center quality data to allow outcome analysis and ongoing audits to ensure quality control and sustainable practice.^[39] Robotic-assisted endoscopic spine surgery is an emerging field with promising outcomes. One of the participants advocated for the application of robotics in LMICs. In summary, the successful adoption of ED in LMICs can be achieved using a “6Ts” framework as follows:^[40-50] Target identification, i.e. accurate diagnosis of patients’ conditions to determine the indication of ED; Technology, referring to wider access to technology to establish and update the endoscopy system; updating Techniques to parallel the evolution of novel and modified techniques; Training, both during and postresidency, using artificial models and cadavers; Testing, which means continuous outcome evaluation; and Talent comprising of innate and acquired surgical skills which can be evaluated using essential metrics, as Melcher *et al.*^[42] developed an essential metric having 42 steps essential to perform unilateral laminotomy for bilateral decompression of lumbar stenosis.

Limitations

Our study is not without limitations. The usage of convenience sampling might be a source of bias and may limit the generalizability of the study. Although years of experience were not associated with the type of the preferred technique, the exclusion of residents and fellows precluded the exploration of the younger generation’s perspective. Some of the included participants did not have appropriate knowledge and exposure to endoscopes which may skew the responses toward MD. Upcoming studies should explore the perspective of spine surgeons regarding the current applications. We did not assess it because of the prematurity of the study at this stage.

CONCLUSION

Spine surgeons preferred MD over ED due to several reasons, such as steep learning curve, lack of training opportunities, upfront expenses, and less provision to handle unforeseen challenges during the surgery. In endoscopic technique, the interlaminar approach was preferred over the transforaminal approach mainly due to anatomical peculiarities of the spine, lesser radiation exposure, and easier handling of

endoscope. There is a gap in the potential benefits and the current usage of ED in LMICs which needs to be bridged with global action.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Sharif S, Shaikh Y, Peev N. Minimally invasive spinal surgery: How to keep out of trouble. *World Neurosurg* 2018;119:517-26.
- Patel PD, Canseco JA, Houlihan N, Gabay A, Grasso G, Vaccaro AR. Overview of minimally invasive spine surgery. *World Neurosurg* 2020;142:43-56.
- Williams RW. Microlumbar discectomy: A conservative surgical approach to the virgin herniated lumbar disc. *Spine (Phila Pa 1976)* 1978;3:175-82.
- Overvest GM, Peul WC, Brand R, Koes BW, Bartels RH, Tan WF, *et al.* Tubular discectomy versus conventional microdiscectomy for the treatment of lumbar disc herniation: Long-term results of a randomised controlled trial. *J Neurol Neurosurg Psychiatry* 2017;88:1008-16.
- Rasouli MR, Rahimi-Movaghar V, Shokraneh F, Moradi-Lakeh M, Chou R. Minimally invasive discectomy versus microdiscectomy/open discectomy for symptomatic lumbar disc herniation. *Cochrane Database Syst Rev* 2014;9:CD010328.
- Ruetten S, Komp M, Merk H, Godolias G. Use of newly developed instruments and endoscopes: Full-endoscopic resection of lumbar disc herniations via the interlaminar and lateral transforaminal approach. *J Neurosurg Spine* 2007;6:521-30.
- Meyer G, DA Rocha ID, Cristante AF, Marcon RM, Coutinho TP, Torelli AG, *et al.* Percutaneous endoscopic lumbar discectomy versus microdiscectomy for the treatment of lumbar disc herniation: Pain, disability, and complication rate—a randomized clinical trial. *Int J Spine Surg* 2020;14:72-8.
- Evaniew N, Bogle A, Soroceanu A, Jacobs WB, Cho R, Fisher CG, *et al.* Minimally invasive tubular lumbar discectomy versus conventional open lumbar discectomy: An observational study from the Canadian spine outcomes and research network. *Global Spine J* 2023;13:1293-303.
- Kim SK, Kang SS, Hong YH, Park SW, Lee SC. Clinical comparison of unilateral biportal endoscopic technique versus open microdiscectomy for single-level lumbar discectomy: A multicenter, retrospective analysis. *J Orthop Surg Res* 2018;13:22.
- Shin DA, Kim KN, Shin HC, Yoon DH. The efficacy of microendoscopic discectomy in reducing iatrogenic muscle injury. *J Neurosurg Spine* 2008;8:39-43.
- Jitpakdee K, Liu Y, Kotheeranurak V, Kim JS. Transforaminal versus interlaminar endoscopic lumbar discectomy for lumbar disc herniation: A systematic review and meta-analysis. *Global Spine J* 2023;13:575-87.
- Xu BS, Tan QS, Xia Q, Ji N, Hu YC. Bilateral decompression via unilateral fenestration using mobile microendoscopic discectomy technique for lumbar spinal stenosis. *Orthop Surg* 2010;2:106-10.
- Ren C, Li Y, Qin R, Sun P, Wang P. Transforaminal endoscopic lumbar discectomy for lumbar disc herniation causing bilateral symptoms. *World Neurosurg* 2017;106:413-21.
- Ahn Y, Kim CH, Lee JH, Lee SH, Kim JS. Radiation exposure to the surgeon during percutaneous endoscopic lumbar discectomy: A prospective study. *Spine (Phila Pa 1976)* 2013;38:617-25.
- Lee S, Kim SK, Lee SH, Kim WJ, Choi WC, Choi G, *et al.* Percutaneous

- endoscopic lumbar discectomy for migrated disc herniation: Classification of disc migration and surgical approaches. *Eur Spine J* 2007;16:431-7.
16. He S, Sun Z, Wang Y, Ma D, Tan W, Lai J. Combining YESS and TESSYS techniques during percutaneous transforaminal endoscopic discectomy for multilevel lumbar disc herniation. *Medicine (Baltimore)* 2018;97:e11240.
 17. Khanna R, Malone H, Keppetipola KM, Deutsch H, Fessler RG, Fontes RB, et al. Multilevel minimally invasive lumbar decompression: Clinical efficacy and durability to 2 years. *Int J Spine Surg* 2021;15:795-802.
 18. Yan D, Zhang Z, Zhang Z. Endoscopic Transforaminal Lumbar Discectomy in the Treatment of Multilevel Disc Herniations. In Review; 2019.
 19. Junjie L, Jiheng Y, Jun L, Haixiong L, Haifeng Y. Comparison of unilateral biportal endoscopy decompression and microscopic decompression effectiveness in lumbar spinal stenosis treatment: A systematic review and meta-analysis. *Asian Spine J* 2023;17:418-30.
 20. Chen T, Zhou G, Chen Z, Yao X, Liu D. Biportal endoscopic decompression versus microscopic decompression for lumbar canal stenosis: A systematic review and meta-analysis. *Exp Ther Med* 2020;20:2743-51.
 21. Komp M, Hahn P, Oezdemir S, Giannakopoulos A, Heikenfeld R, Kasch R, et al. Bilateral spinal decompression of lumbar central stenosis with the full-endoscopic interlaminar versus microsurgical laminotomy technique: A prospective, randomized, controlled study. *Pain Physician* 2015;18:61-70.
 22. Ruetten S, Komp M. Endoscopic lumbar decompression. *Neurosurg Clin N Am* 2020;31:25-32.
 23. Jiang X, Zhou X, Xu N. Clinical effects of transforaminal and interlaminar percutaneous endoscopic discectomy for lumbar disc herniation: A retrospective study. *Medicine (Baltimore)* 2018;97:e13417.
 24. Kim JY, Kim HS, Jeon JB, Lee JH, Park JH, Jang IT. The novel technique of uniportal endoscopic interlaminar contralateral approach for coexisting L5-S1 lateral recess, foraminal, and extraforaminal stenosis and its clinical outcomes. *J Clin Med* 2021;10:1364.
 25. Law JD, Lehman RA, Kirsch WM. Reoperation after lumbar intervertebral disc surgery. *J Neurosurg* 1978;48:259-63.
 26. Kim SS, Michelsen CB. Revision surgery for failed back surgery syndrome. *Spine (Phila Pa 1976)* 1992;17:957-60.
 27. Stolke D, Sollmann WP, Seifert V. Intra- and postoperative complications in lumbar disc surgery. *Spine (Phila Pa 1976)* 1989;14:56-9.
 28. Ruetten S, Komp M, Merk H, Godolias G. Recurrent lumbar disc herniation after conventional discectomy: A prospective, randomized study comparing full-endoscopic interlaminar and transforaminal versus microsurgical revision. *J Spinal Disord Tech* 2009;22:122-9.
 29. Yoshikane K, Kikuchi K, Izumi T, Okazaki K. Full-endoscopic lumbar discectomy for recurrent lumbar disc herniation: A retrospective study with patient-reported outcome measures. *Spine Surg Relat Res* 2021;5:272-7.
 30. Kim HS, Adsul N, Ju YS, Kim KJ, Choi SH, Kim JH, et al. Full endoscopic lumbar discectomy using the calcification floating technique for symptomatic partially calcified lumbar herniated nucleus pulposus. *World Neurosurg* 2018;119:500-5.
 31. Wang D, Xing J, Shao B, Su H, Zhang X, Zhao W, et al. A surgical decompression procedure for effective treatment of calcified lumbar disc herniation. *Journal of International Medical Research* 2020;48:0300060520938966.
 32. Cheng YP, Cheng XK, Wu H. A comparative study of percutaneous endoscopic interlaminar discectomy and transforaminal discectomy for L5-S1 calcified lumbar disc herniation. *BMC Musculoskelet Disord* 2022;23:244.
 33. Pahwa B, Chaurasia B, Garg K, Bozkurt I, Deora H. Factors affecting the choice of neurosurgery subspecialty: A geographic and gender-wise analysis. *World Neurosurg* 2023;171:e864-73.
 34. Yadav YR, Lucano A, Ratre S, Parihar VS. Practical aspects and avoidance of complications in microendoscopic spine surgeries: A review. *J Neurol Surg A Cent Eur Neurosurg* 2019;80:291-301.
 35. Yadav YR, Parihar V, Ratre S, Kher Y, Iqbal M. Microneurosurgical skills training. *J Neurol Surg A Cent Eur Neurosurg* 2016;77:146-54.
 36. Choi KC, Shim HK, Kim JS, Cha KH, Lee DC, Kim ER, et al. Cost-effectiveness of microdiscectomy versus endoscopic discectomy for lumbar disc herniation. *Spine J* 2019;19:1162-9.
 37. Nicolosi F, Rossini Z, Zaed I, Koliias AG, Fornari M, Servadei F. Neurosurgical digital teaching in low-middle income countries: Beyond the frontiers of traditional education. *Neurosurg Focus* 2018;45:E17.
 38. Haglund MM, Kiryabwire J, Parker S, Zomorodi A, MacLeod D, Schroeder R, et al. Surgical capacity building in Uganda through twinning, technology, and training camps. *World J Surg* 2011;35:1175-82.
 39. Gheza F, Oginni FO, Crivellaro S, Masrur MA, Adisa AO. Affordable laparoscopic camera system (ALCS) designed for low- and middle-income countries: A feasibility study. *World J Surg* 2018;42:3501-7.
 40. Goldberg JL, Hussain I, Sommer F, Härtl R, Elowitz E. The future of minimally invasive spinal surgery. *World Neurosurg* 2022;163:233-40.
 41. Härtl R. The 6 T's of minimally invasive spine surgery. *Global Spine J* 2020;10:5S-7S.
 42. Melcher C, Korge A, Cunningham M, Foley KT, Härtl R. Metrics development for minimal invasive unilateral laminotomy for bilateral decompression of lumbar spinal stenosis with and without spondylolisthesis by an international expert panel. *Global Spine J* 2020;10:168S-75S.
 43. Ahsan K, Khan SI, Zaman N, Ahmed N, Montemurro N, Chaurasia B. Fusion versus nonfusion treatment for recurrent lumbar disc herniation. *J Craniovertebr Junction Spine* 2021;12:44-53.
 44. Nicoletti GF, Umama GE, Chaurasia B, Ponzio G, Giuffrida M, Vasta G, et al. Navigation-assisted extraforaminal lumbar disc microdiscectomy: Technical note. *J Craniovertebr Junction Spine* 2020;11:316-20.
 45. Palmisciano P, Balasubramanian K, Scalia G, Sagoo NS, Haider AS, Bin Alamer O, et al. Posterior epidural intervertebral disc migration and sequestration: A systematic review. *J Clin Neurosci* 2022;98:115-26.
 46. Nurmukhametov R, Dosanov M, Encarnacion MD, Barrientos R, Matos Y, Alyokhin AI, et al. Transforaminal fusion using physiologically integrated titanium cages with a novel design in patients with degenerative spinal disorders: A pilot study. *Surgeries* 2022;3:175-84.
 47. Ahsan K, Hasan S, Khan SI, Zaman N, Almasri SS, Ahmed N, et al. Conservative versus operative management of postoperative lumbar discitis. *J Craniovertebr Junction Spine* 2020;11:198-209.
 48. Ahsan MK, Hossain MR, Khan MS, Zaman N, Ahmed N, Montemurro N, et al. Lumbar revision microdiscectomy in patients with recurrent lumbar disc herniation: A single-center prospective series. *Surg Neurol Int* 2020;11:404.
 49. Kononov A, Grebenev F, Asyutin D, Zakirov B, Kononov N, Pronin I, et al. Spinal dural cerebrospinal fluid fistula as a cause of spontaneous intracranial hypotension syndrome: Diagnosis and surgical treatment. *J Craniovertebr Junction Spine* 2023;14:108-12.
 50. Ramnarayan R, Chaurasia B. The post spinal surgery syndrome: A review. *J Craniovertebr Junction Spine* 2023;14:4-10.