MASSACHUSETTS

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Medical Policy

Automated Percutaneous and Percutaneous Discectomy

Table of Contents

Policy Number: 231

BCBSA Reference Number: 7.01.18 (For Plan internal use only)
NCD/LCD: N/A

Related Policies

- Decompression of the Intervertebral Disc Using Laser Energy (Laser Discectomy) or Radiofrequency Coblation (Nucleoplasty), #271
- Percutaneous Intradiscal Electrothermal Annuloplasty, Radiofrequency Annuloplasty, and Biacuplasty, #482

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity Medicare HMO Blue℠ and Medicare PPO Blue℠ Members

Automated percutaneous discectomy is considered **INVESTIGATIONAL** as a technique of intervertebral disc decompression in individuals with back pain and/or radiculopathy related to disc herniation in the lumbar, thoracic, or cervical spine.

Percutaneous endoscopic discectomy is considered **INVESTIGATIONAL** as a technique of intervertebral disc decompression in individuals with back pain and/or radiculopathy related to disc herniation in the lumbar, thoracic, or cervical spine.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	This is **not** a covered service.
Commercial PPO and Indemnity	This is **not** a covered service.
Medicare HMO Blue℠	This is **not** a covered service.

Medicare PPO Blue℠	This is **not** a covered service.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The following CPT codes are considered investigational for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

CPT Codes

CPT codes:	Code Description
62287	Decompression procedure, percutaneous, of nucleus pulposus of intervertebral disc, any method utilizing needle-based technique to remove disc material under fluoroscopic imaging or other form of indirect visualization, with the use of an endoscope, with discography and/or epidural injection(s) at the treated level(s), when performed, single or multiple levels, lumbar

Description

Back pain or radiculopathy related to herniated discs is an extremely common condition and a frequent cause of chronic disability. Although many cases of acute low back pain and radiculopathy will resolve with conservative care, surgical decompression is often considered when the pain is unimproved after several months and is clearly neuropathic in origin, resulting from irritation of the nerve roots. Open surgical treatment typically consists of discectomy in which the extruding disc material is excised. When performed with an operating microscope, the procedure is known as a microdiscectomy.

Minimally invasive options have also been researched, in which some portion of the disc is removed or ablated, although these techniques are not precisely targeted at the offending extruding disc material. Ablative techniques include laser discectomy and radiofrequency decompression (see policy #271). Intradiscal electrothermal annuloplasty is another minimally invasive approach to low back pain. In this technique, radiofrequency energy is used to treat the surrounding disc annulus (see policy #482).

Herein, BCBSA addresses automated percutaneous and endoscopic discectomy, in which the disc decompression is accomplished by the physical removal of disc material rather than its ablation. Traditionally, discectomy was performed manually through an open incision, using cutting forceps to remove nuclear material from within the disc annulus. This technique was modified by automated devices that involve placement of a probe within the intervertebral disc and aspiration of disc material using a suction cutting device. Endoscopic techniques may be intradiscal or may involve extraction of noncontained and sequestered disc fragments from inside the spinal canal using an interlaminar or transforaminal approach. Following insertion of the endoscope, decompression is performed under visual control.

Summary

Description

Surgical management of herniated intervertebral discs most commonly involves discectomy or microdiscectomy, performed manually through an open incision. Automated percutaneous discectomy involves placement of a probe within the intervertebral disc under image guidance with aspiration of disc material using a suction cutting device. Endoscopic discectomy involves the percutaneous placement of a

working channel under image guidance, followed by visualization of the working space and instrumentation through an endoscope, and aspiration of disc material.

Summary of Evidence
For individuals who have herniated intervertebral disc(s) who receive automated percutaneous discectomy, the evidence includes randomized controlled trials (RCTs) and systematic reviews of observational studies. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. The published evidence from small RCTs is insufficient to evaluate the impact of automated percutaneous discectomy on the net health outcome. Well-designed and executed RCTs are needed to determine the benefits and risks of this procedure. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have herniated intervertebral disc(s) who receive percutaneous endoscopic discectomy, the evidence includes a number of RCTs, systematic reviews, and observational studies. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. Many of the more recent RCTs are conducted at institutions within China. There are few reports from the United States. Results do not reveal a consistently significant improvement in patient-reported outcomes and treatment-related morbidity with percutaneous endoscopic discectomy in comparison to other discectomy interventions. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Additional Information
2018 Input
Clinical input was sought to help determine whether the use of automated percutaneous discectomy or endoscopic percutaneous discectomy for individuals with herniated intervertebral discs would provide a clinically meaningful improvement in net health outcome and whether the use is consistent with generally accepted medical practice. In response to requests, clinical input was received from 3 respondents, including 2 specialty society-level response(s); no physician-level responses identified through a specialty society; 1 physician-level response identified through an academic medical center.

For individuals who have herniated intervertebral discs who receive automated percutaneous discectomy or percutaneous endoscopic discectomy, clinical input does not support a clinically meaningful improvement in net health outcome and does not indicate this use is consistent with generally accepted medical practice. Clinical input suggests that automated percutaneous discectomy may be an appropriate treatment option for the highly selected patient who has a small focal disc fragment compressing a lumbar nerve causing radiculopathy in the absence of lumbar stenosis or severe bony foraminal stenosis. Similarly, clinical input suggests that endoscopic percutaneous discectomy may be an appropriate treatment option for the highly selected patient who has a small focal disc herniation causing lumbar radiculopathy. However, respondents were mixed in the level of support for this indication, and overall the clinical input is not generally supportive of a clinically meaningful improvement in net health outcome.

Policy History

Date	Action
8/2023	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
8/2022	Annual policy review. References added. Minor editorial refinements to policy statements; intent unchanged.
8/2020	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
12/2019	Investigational criteria on endoscopic discectomy removed. Endoscopic discectomy is considered a covered service. Clarified coding information. Effective 12/1/2019.
2/2019	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
6/2017	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
1/2017	Clarified coding information for the 2017 code changes.

5/2016	Annual policy review. New references added.
11/2015	Added coding language.
6/2015	Annual policy review. New references added.
7/2014	Annual policy review. New references added.
10/2013	Annual policy review. Policy statement clarified to read: back pain and/or radiculopathy.
2/2013	Annual policy review. Changes to policy statement. Effective 2/2013.
11/2011-4/2012	Medical policy ICD 10 remediation: Formatting, editing and coding updates. No changes to policy statements.
1/2011	Medical Policy Group – Neurology and Neurosurgery. No changes to policy statements.
9/1/10	Medical Policy 231, effective 9/1/10, describing ongoing non-coverage.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:

Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines
Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Lewis RA, Williams NH, Sutton AJ, et al. Comparative clinical effectiveness of management strategies for sciatica: systematic review and network meta-analyses. Spine J. Jun 01 2015; 15(6): 1461-77. PMID 24412033
2. Haines SJ, Jordan N, Boen JR, et al. Discectomy strategies for lumbar disc herniation: results of the LAPDOG trial. J Clin Neurosci. Jul 2002; 9(4): 411-7. PMID 12217670
3. Manchikanti L, Abdi S, Atluri S, et al. An update of comprehensive evidence-based guidelines for interventional techniques in chronic spinal pain. Part II: guidance and recommendations. Pain Physician. Apr 2013; 16(2 Suppl): S49-283. PMID 23615883
4. Phan K, Xu J, Schultz K, et al. Full-endoscopic versus micro-endoscopic and open discectomy: A systematic review and meta-analysis of outcomes and complications. Clin Neurol Neurosurg. Mar 2017; 154: 1-12. PMID 28086154
5. Shi R, Wang F, Hong X, et al. Comparison of percutaneous endoscopic lumbar discectomy versus microendoscopic discectomy for the treatment of lumbar disc herniation: a meta-analysis. Int Orthop. Apr 2019; 43(4): 923-937. PMID 30547214
6. Yu P, Qiang H, Zhou J, et al. Percutaneous Transforaminal Endoscopic Discectomy versus Micro-Endoscopic Discectomy for Lumbar Disc Herniation. Med Sci Monit. Mar 30 2019; 25: 2320-2328. PMID 30927349
7. Zhao XM, Yuan QL, Liu L, et al. Is It Possible to Replace Microendoscopic Discectomy with Percutaneous Transforaminal Discectomy for Treatment of Lumbar Disc Herniation? A Meta-Analysis Based on Recurrence and Revision Rate. J Korean Neurosurg Soc. Jul 2020; 63(4): 477-486. PMID 32380585
8. Xu J, Li Y, Wang B, et al. Minimum 2-Year Efficacy of Percutaneous Endoscopic Lumbar Discectomy versus Microendoscopic Discectomy: A Meta-Analysis. World Neurosurg. Jun 2020; 138: 19-26. PMID 32109644
9. Bai X, Lian Y, Wang J, et al. Percutaneous endoscopic lumbar discectomy compared with other surgeries for lumbar disc herniation: A meta-analysis. Medicine (Baltimore). Mar 05 2021; 100(9): e24747. PMID 33655938
10. Gadjradj PS, Harhangi BS, Amelink J, et al. Percutaneous Transforaminal Endoscopic Discectomy Versus Open Microdiscectomy for Lumbar Disc Herniation: A Systematic Review and Meta-analysis. Spine (Phila Pa 1976). Apr 15 2021; 46(8): 538-549. PMID 33290374
11. Zhao XM, Chen AF, Lou XX, et al. Comparison of Three Common Intervertebral Disc Discectomies in the Treatment of Lumbar Disc Herniation: A Systematic Review and Meta-Analysis Based on Multiple Data. J Clin Med. Nov 08 2022; 11(22). PMID 36431083

12. Ma C, Li H, Zhang T, et al. Comparison of Percutaneous Endoscopic Interlaminar Discectomy and Open Fenestration Discectomy for Single-Segment Huge Lumbar Disc Herniation: A Two-year Follow-up Retrospective Study. J Pain Res. 2022; 15: 1061-1070. PMID 35444463
13. Wang SF, Hung SF, Tsai TT, et al. Better Functional Outcome and Pain Relief in the Far-Lateral-Outside-in Percutaneous Endoscopic Transforaminal Discectomy. J Pain Res. 2021; 14: 3927-3934. PMID 35002312
14. Rajamani PA, Goparaju P, Kulkarni AG, et al. A 2-Year Outcomes and Complications of Various Techniques of Lumbar Discectomy: A Multicentric Retrospective Study. World Neurosurg. Dec 2021; 156: e319-e328. PMID 34555576
15. Jing Z, Li L, Song J. Percutaneous transforaminal endoscopic discectomy versus microendoscopic discectomy for upper lumbar disc herniation: a retrospective comparative study. Am J Transl Res. 2021; 13(4): 3111-3119. PMID 34017479
16. Jarebi M, Awaf A, Lefranc M, et al. A matched comparison of outcomes between percutaneous endoscopic lumbar discectomy and open lumbar microdiscectomy for the treatment of lumbar disc herniation: a 2-year retrospective cohort study. Spine J. Jan 2021; 21(1): 114-121. PMID 32683107
17. Meyer G, DA Rocha ID, Cristante AF, 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. Feb 2020; 14(1): 72-78. PMID 32128306
18. Chen Z, Zhang L, Dong J, et al. Percutaneous Transforaminal Endoscopic Discectomy Versus Microendoscopic Discectomy for Lumbar Disc Herniation: Two-Year Results of a Randomized Controlled Trial. Spine (Phila Pa 1976). Apr 15 2020; 45(8): 493-503. PMID 31703056
19. Kim CH, Chung CK, Choi Y, et al. The Long-term Reoperation Rate Following Surgery for Lumbar Herniated Intervertebral Disc Disease: A Nationwide Sample Cohort Study With a 10-year Follow-up. Spine (Phila Pa 1976). Oct 01 2019; 44(19): 1382-1389. PMID 30973508
20. Ahn Y, Lee SG, Son S, et al. Transforaminal Endoscopic Lumbar Discectomy Versus Open Lumbar Microdiscectomy: A Comparative Cohort Study with a 5-Year Follow-Up. Pain Physician. May 2019; 22(3): 295-304. PMID 31151337
21. Liu X, Yuan S, Tian Y, et al. Comparison of percutaneous endoscopic transforaminal discectomy, microendoscopic discectomy, and microdiscectomy for symptomatic lumbar disc herniation: minimum 2-year follow-up results. J Neurosurg Spine. Mar 2018; 28(3): 317-325. PMID 29303471
22. Sun Y, Zhang W, Qie S, et al. Comprehensive comparing percutaneous endoscopic lumbar discectomy with posterior lumbar internal fixation for treatment of adjacent segment lumbar disc prolapse with stable retrolisthesis: A retrospective case-control study. Medicine (Baltimore). Jul 2017; 96(29): e7471. PMID 28723757
23. Jeong, J.S.; Lee, S.H.; Lee, S.J.; Hwang, B.W. The Clinical Comparison between Open Surgery and Percutaneous Endoscopic Lumbar Discectomy in Extraforaminal Lumbar Disc Herniation. J. Korean Neurosurg. Soc. 2006, 39, 413418.
24. Akçakaya MO, Yörükoğlu AG, Aydoseli A, et al. Serum creatine phosphokinase levels as an indicator of muscle injury following lumbar disc surgery: Comparison of fully endoscopic discectomy and microdiscectomy. Clin Neurol Neurosurg. Jun 2016; 145: 74-8. PMID 27101087
25. Choi KC, Shim HK, Hwang JS, et al. Comparison of Surgical Invasiveness Between Microdiscectomy and 3 Different Endoscopic Discectomy Techniques for Lumbar Disc Herniation. World Neurosurg. Aug 2018; 116: e750-e758. PMID 29787880
26. Dai HJ, Zhang X, Wang LT, et al. The effect of percutaneous transforaminal endoscopic discectomy (PTED) on serum inflammatory factors and pain in patients with lumbar disc herniation after surgery. Int J Clin Exp Med 2020;13:597603.
27. Krappel FA, Schmitz R, Bauer E, et al. Open or endoscopic nucleotomy?. Orthopadische Praxis 2001;37:1649.
28. Tacconi L, Giordan E. Endoscopic transforaminal discectomy vs. far lateral discectomy for extraforaminal disc protrusions: our experience. NeuroQuantology 2019;17:1822.
29. Tacconi L, Signorelli F, Giordan E. Is Full Endoscopic Lumbar Discectomy Less Invasive Than Conventional Surgery? A Randomized MRI Study. World Neurosurg. Jun 2020; 138: e867-e875. PMID 32251813
30. Tao XZ, Jing L, Li JH. Therapeutic effect of transforaminal endoscopic spine system in the treatment of prolapse of lumbar intervertebral disc. Eur Rev Med Pharmacol Sci. Jul 2018; 22(1 Suppl): 103-110. PMID 30004561

31. Wang H, Song Y, Cai L. Effect of percutaneous transforaminal lumbar spine endoscopic discectomy on lumbar disc herniation and its influence on indexes of oxidative stress. Biomed Res 2017;28:.
32. Xu G, Zhang C, Zhu K, et al. Endoscopic removal of nucleus pulposus of intervertebral disc on lumbar intervertebral disc protrusion and the influence on inflammatory factors and immune function. Exp Ther Med. Jan 2020; 19(1): 301-307. PMID 31853303
33. Ahn SS, Kim SH, Kim DW, et al. Comparison of Outcomes of Percutaneous Endoscopic Lumbar Discectomy and Open Lumbar Microdiscectomy for Young Adults: A Retrospective Matched Cohort Study. World Neurosurg. Feb 2016; 86: 250-8. PMID 26409086
34. Chang F, Zhang T, Gao G, et al. Therapeutic effect of percutaneous endoscopic lumbar discectomy on lumbar disc herniation and its effect on oxidative stress in patients with lumbar disc herniation. Exp Ther Med. Jan 2018; 15(1): 295-299. PMID 29250152
35. Liu C, Zhou Y. Percutaneous Endoscopic Lumbar Diskectomy and Minimally Invasive Transforaminal Lumbar Interbody Fusion for Recurrent Lumbar Disk Herniation. World Neurosurg. Feb 2017; 98: 14-20. PMID 27773858
36. Pan Z, Ha Y, Yi S, et al. Efficacy of Transforaminal Endoscopic Spine System (TESSYS) Technique in Treating Lumbar Disc Herniation. Med Sci Monit. Feb 18 2016; 22: 530-9. PMID 26887645
37. Yao Y, Zhang H, Wu J, et al. Comparison of Three Minimally Invasive Spine Surgery Methods for Revision Surgery for Recurrent Herniation After Percutaneous Endoscopic Lumbar Discectomy. World Neurosurg. Apr 2017; 100: 641-647.e1. PMID 28153616
38. Yao Y, Zhang H, Wu J, et al. Minimally Invasive Transforaminal Lumbar Interbody Fusion Versus Percutaneous Endoscopic Lumbar Discectomy: Revision Surgery for Recurrent Herniation After Microendoscopic Discectomy. World Neurosurg. Mar 2017; 99: 89-95. PMID 27919762
39. Gibson JNA, Subramanian AS, Scott CEH. A randomised controlled trial of transforaminal endoscopic discectomy vs microdiscectomy. Eur Spine J. Mar 2017; 26(3): 847-856. PMID 27885470
40. Hsu HT, Chang SJ, Yang SS, et al. Learning curve of full-endoscopic lumbar discectomy. Eur Spine J. Apr 2013; 22(4): 727-33. PMID 23076645
41. Kim MJ, Lee SH, Jung ES, et al. Targeted percutaneous transforaminal endoscopic diskectomy in 295 patients: comparison with results of microscopic diskectomy. Surg Neurol. Dec 2007; 68(6): 623-631. PMID 18053857
42. Qu JX, Li QZ, Chen M : Comparative study of PTED and MED for monosegmentnlumbar disc herniation. Chin J Bone Joint Inj 32 : 70-71,2017
43. Wang H, Cheng J, Xiao H, et al. Adolescent lumbar disc herniation: experience from a large minimally invasive treatment centre for lumbar degenerative disease in Chongqing, China. Clin Neurol Neurosurg. Aug 2013; 115(8): 1415-9. PMID 23419406
44. Zhao W, Li CQ, Zhou Y, Wang J, Zheng WJ : Surgical treatment of thenlumbar disc herniated discs using transforaminal endoscopic surgerynsystem. Orthop J China 20 : 1191-1195, 2012
45. Yoon SM, Ahn SS, Kim KH, et al. Comparative Study of the Outcomes of Percutaneous Endoscopic Lumbar Discectomy and Microscopic Lumbar Discectomy Using the Tubular Retractor System Based on the VAS, ODI, and SF-36. Korean J Spine. Sep 2012; 9(3): 215-22. PMID 25983818
46. Li M, Yang H, Yang Q. Full-Endoscopic Technique Discectomy Versus Microendoscopic Discectomy for the Surgical Treatment of Lumbar Disc Herniation. Pain Physician. 2015; 18(4): 359-63. PMID 26218939
47. Sinkemani A, Hong X, Gao ZX, et al. Outcomes of Microendoscopic Discectomy and Percutaneous Transforaminal Endoscopic Discectomy for the Treatment of Lumbar Disc Herniation: A Comparative Retrospective Study. Asian Spine J. Dec 2015; 9(6): 833-40. PMID 26713113
48. Song HP, Sheng HF, Xu WX. A case-control study on the treatment of protrusion of lumbar intervertebral disc through PELD and MED. Exp Ther Med. Oct 2017; 14(4): 3708-3712. PMID 29042967
49. Tu Z, Li YW, Wang B, et al. Clinical Outcome of Full-endoscopic Interlaminar Discectomy for Single-level Lumbar Disc Herniation: A Minimum of 5-year Follow-up. Pain Physician. Mar 2017; 20(3): E425-E430. PMID 28339442
50. Li H, Jiang C, Mu X, et al. Comparison of MED and PELD in the Treatment of Adolescent Lumbar Disc Herniation: A 5-Year Retrospective Follow-Up. World Neurosurg. Apr 2018; 112: e255-e260. PMID 29325949
51. Abudurexiti T, Qi L, Muheremu A, et al. Micro-endoscopic discectomy versus percutaneous endoscopic surgery for lumbar disk herniation. J Int Med Res. Sep 2018; 46(9): 3910-3917. PMID 29900752

52. Chen Z, Zhang L, Dong J, et al. Percutaneous transforaminal endoscopic discectomy compared with microendoscopic discectomy for lumbar disc herniation: 1-year results of an ongoing randomized controlled trial. J Neurosurg Spine. Mar 2018; 28(3): 300-310. PMID 29303469
53. Liu T, Zhou Y, Wang J, et al. Clinical efficacy of three different minimally invasive procedures for far lateral lumbar disc herniation. Chin Med J (Engl). Mar 2012; 125(6): 1082-8. PMID 22613535
54. Wu XC, Zhou Y, Li CQ. Percutaneous tranforaminal endoscopic discectomy versus microendoscopic discectomy for lumbar disc herniation: a prospective randomized controlled study. J Third Mil Med Univ. 2009;31(9):843-846.
55. Yang L, Liao XQ, Zhao XJ, et al. Comparison of surgical outcomes between percutaneous transforaminal endoscopic discectomy and micro-endoscopic discectomy for lumbar disc herniation. China J Endosc. 2015;21(9):962-965
56. Duan XF, Jin W, Chen JJ, et al. Contrast observation of comparing microendoscopic discectomy with percutaneous endoscopic lumbar discectomy for the treatment of simple lumbar disc herniation. Chin J Clin. 2016;10(1):144-147
57. Zhao XW, Han K, Ji ZW, et al. Comparison of efficacy between microendoscopic discectomy and percutaneous endoscopic lumbar discectomy for treatment of lumbar disc herniation. Prog Mod Biomed. 2016;16(23):4454-4457
58. Ding YZ, Hu JN, Zhou Y, et al. Study on the effect contrast between microendoscopic discectomy and percutaneous endoscopic lumbar discectomy using TESSYS technique for the treatment of lumbar disc herniation. J Cervicodynia & Lumbodynia. 2017;38(5):492-493
59. Li ZY, Guo PG, Han D, et al. Analysis of curative effects and prognosis in different procedures of discectomy for patients with lumbar disc herniation. J Clin Med Pract. 2017;21(15):149-150,158
60. Liu HP, Hao DJ, Wang XD, et al. Comparison of two surgeries in treatment of lumbar disc herniation. Chin J Pain Med. 2017;23(6):438-442
61. Luo DK, Zhou NX, Zhao HW, et al. Clinical effectiveness of minimally invasive treatment for lumbar disc herniation. Orthopaedics. 2017;8(6):439-444
62. Qu JX, Li QZ, Chem M, et al. Comparison of the efficacies between percutaneous transforaminal endoscopic discectomy and microendoscopic discectomy for the treatment of single-segmental lumbar disc herniation. Chin J Bone Jt Inj. 2017;32(1):70-71
63. Chen Q, Qin L, Li MW, et al. Comparison of the therapeutic effect of percutaneous transforaminal endoscopic discectomy and posterior discectomy on senile single segmental lumbar disc herniation. Chin J Front Med Sci. 2018;10(2):60-64
64. Wu YM, Bai M, Yin HP, et al. Comparison of the efficacies between two kinds of minimally invasive procedures for the treatment of simple lumbar disc herniation. J Pract Orthop. 2018;24(4):357-360
65. Belykh E, Giers MB, Preul MC, et al. Prospective Comparison of Microsurgical, Tubular-Based Endoscopic, and Endoscopically Assisted Diskectomies: Clinical Effectiveness and Complications in Railway Workers. World Neurosurg. Jun 2016; 90: 273-280. PMID 26898494
66. Chen HC, Lee CH, Wei L, et al. Comparison of percutaneous endoscopic lumbar discectomy and open lumbar surgery for adjacent segment degeneration and recurrent disc herniation. Neurol Res Int. 2015; 2015: 791943. PMID 25861474
67. Choi KC, Kim JS, Park CK. Percutaneous Endoscopic Lumbar Discectomy as an Alternative to Open Lumbar Microdiscectomy for Large Lumbar Disc Herniation. Pain Physician. Feb 2016; 19(2): E291-300. PMID 26815256
68. Garg B, Nagraja UB, Jayaswal A. Microendoscopic versus open discectomy for lumbar disc herniation: a prospective randomised study. J Orthop Surg (Hong Kong). Apr 2011; 19(1): 30-4. PMID 21519072
69. Hermantin FU, Peters T, Quartararo L, et al. A prospective, randomized study comparing the results of open discectomy with those of video-assisted arthroscopic microdiscectomy. J Bone Joint Surg Am. Jul 1999; 81(7): 958-65. PMID 10428127
70. Huang TJ, Hsu RW, Li YY, et al. Less systemic cytokine response in patients following microendoscopic versus open lumbar discectomy. J Orthop Res. Mar 2005; 23(2): 406-11. PMID 15734255
71. Hussein M, Abdeldayem A, Mattar MM. Surgical technique and effectiveness of microendoscopic discectomy for large uncontained lumbar disc herniations: a prospective, randomized, controlled study with 8 years of follow-up. Eur Spine J. Sep 2014; 23(9): 1992-9. PMID 24736930

72. Kleinpeter G, Markowitsch MM, Böck F. Percutaneous endoscopic lumbar discectomy: minimally invasive, but perhaps only minimally useful?. Surg Neurol. Jun 1995; 43(6): 534-9; discussion 540-1. PMID 7482230
73. Lee DY, Shim CS, Ahn Y, et al. Comparison of percutaneous endoscopic lumbar discectomy and open lumbar microdiscectomy for recurrent disc herniation. J Korean Neurosurg Soc. Dec 2009; 46(6): 515-21. PMID 20062565
74. Martín-Láez R, Martínez-Agüeros JA, Suárez-Fernández D, et al. Complications of endoscopic microdiscectomy using the EASYGO! system: is there any difference with conventional discectomy during the learning-curve period?. Acta Neurochir (Wien). Jun 2012; 154(6): 1023-32. PMID 22446750
75. Mayer HM, Brock M. Percutaneous endoscopic discectomy: surgical technique and preliminary results compared to microsurgical discectomy. J Neurosurg. Feb 1993; 78(2): 216-25. PMID 8267686
76. Ohya J, Oshima Y, Chikuda H, et al. Does the microendoscopic technique reduce mortality and major complications in patients undergoing lumbar discectomy? A propensity score-matched analysis using a nationwide administrative database. Neurosurg Focus. Feb 2016; 40(2): E5. PMID 26828886
77. Pan L, Zhang P, Yin Q. Comparison of tissue damages caused by endoscopic lumbar discectomy and traditional lumbar discectomy: a randomised controlled trial. Int J Surg. 2014; 12(5): 534-7. PMID 24583364
78. Righesso O, Falavigna A, Avanzi O. Comparison of open discectomy with microendoscopic discectomy in lumbar disc herniations: results of a randomized controlled trial. Neurosurgery. Sep 2007; 61(3): 545-9; discussion 549. PMID 17881967
79. Ruetten S, Komp M, Merk H, et al. Full-endoscopic interlaminar and transforaminal lumbar discectomy versus conventional microsurgical technique: a prospective, randomized, controlled study. Spine (Phila Pa 1976). Apr 20 2008; 33(9): 931-9. PMID 18427312
80. Ruetten S, Komp M, Merk H, et al. Recurrent lumbar disc herniation after conventional discectomy: a prospective, randomized study comparing full-endoscopic interlaminar and transforaminal versus microsurgical revision. J Spinal Disord Tech. Apr 2009; 22(2): 122-9. PMID 19342934
81. Sasaoka R, Nakamura H, Konishi S, et al. Objective assessment of reduced invasiveness in MED. Compared with conventional one-level laminotomy. Eur Spine J. May 2006; 15(5): 577-82. PMID 15926058
82. Schizas C, Tsiridis E, Saksena J. Microendoscopic discectomy compared with standard microsurgical discectomy for treatment of uncontained or large contained disc herniations. Neurosurgery. Oct 2005; 57(4 Suppl): 357-60; discussion 357-60. PMID 16234685
83. Teli M, Lovi A, Brayda-Bruno M, et al. Higher risk of dural tears and recurrent herniation with lumbar micro-endoscopic discectomy. Eur Spine J. Mar 2010; 19(3): 443-50. PMID 20127495
84. Ruetten S, Komp M, Merk H, et al. Use of newly developed instruments and endoscopes: full-endoscopic resection of lumbar disc herniations via the interlaminar and lateral transforaminal approach. J Neurosurg Spine. Jun 2007; 6(6): 521-30. PMID 17561740
85. Ruetten S, Komp M, Merk H, et al. Full-endoscopic cervical posterior foraminotomy for the operation of lateral disc herniations using 5.9-mm endoscopes: a prospective, randomized, controlled study. Spine (Phila Pa 1976). Apr 20 2008; 33(9): 940-8. PMID 18427313
86. Lee SH, Chung SE, Ahn Y, et al. Comparative radiologic evaluation of percutaneous endoscopic lumbar discectomy and open microdiscectomy: a matched cohort analysis. Mt Sinai J Med. Sep 2006; 73(5): 795-801. PMID 17008941
87. Gadjradj PS, Rubinstein SM, Peul WC, et al. Full endoscopic versus open discectomy for sciatica: randomised controlled non-inferiority trial. BMJ. Feb 21 2022; 376: e065846. PMID 35190388
88. Ran B, Wei J, Yang J, et al. Quantitative Evaluation of the Trauma of CT Navigation PELD and OD in the Treatment of HLDH: A Randomized, Controlled Study. Pain Physician. Jul 2021; 24(4): E433-E441. PMID 34213868
89. Wang F, Guo D, Sun T, et al. A comparative study on short-term therapeutic effects of percutaneous transforaminal endoscopic discectomy and microendoscopic discectomy on lumbar disc herniation. Pak J Med Sci. 2019; 35(2): 426-431. PMID 31086527
90. Lee DY, Lee SH. Learning curve for percutaneous endoscopic lumbar discectomy. Neurol Med Chir (Tokyo). Sep 2008; 48(9): 383-8; discussion 388-9. PMID 18812679
91. Wang B, Lü G, Patel AA, et al. An evaluation of the learning curve for a complex surgical technique: the full endoscopic interlaminar approach for lumbar disc herniations. Spine J. Feb 2011; 11(2): 122-30. PMID 21296295

92. Tenenbaum S, Arzi H, Herman A, et al. Percutaneous Posterolateral Transforaminal Endoscopic Discectomy: Clinical Outcome, Complications, and Learning Curve Evaluation. Surg Technol Int. Dec 2011; 21: 278-83. PMID 22505002
93. Casal-Moro R, Castro-Menéndez M, Hernández-Blanco M, et al. Long-term outcome after microendoscopic diskectomy for lumbar disk herniation: a prospective clinical study with a 5-year follow-up. Neurosurgery. Jun 2011; 68(6): 1568-75; discussion 1575. PMID 21311384
94. Wang M, Zhou Y, Wang J, et al. A 10-year follow-up study on long-term clinical outcomes of lumbar microendoscopic discectomy. J Neurol Surg A Cent Eur Neurosurg. Aug 2012; 73(4): 195-8. PMID 22825836
95. Choi KC, Lee JH, Kim JS, et al. Unsuccessful percutaneous endoscopic lumbar discectomy: a single-center experience of 10,228 cases. Neurosurgery. Apr 2015; 76(4): 372-80; discussion 380-1; quiz 381. PMID 25599214
96. National Institute for Health and Care Excellence (NICE). Automated percutaneous mechanical lumbar discectomy-guidance [IPG141]. 2005; http://guidance.nice.org.uk/IPG141/Guidance/pdf/English. Accessed May 8, 2023.
97. National Institute for Health and Care Excellence (NICE). Percutaneous interlaminar endoscopic lumbar discectomy for sciatica [IPG555]. 2016; https://www.nice.org.uk/guidance/ipg555. Accessed May 7, 2023.
98. National Institute for Health and Care Excellence (NICE). Percutaneous transforaminal endoscopic lumbar discectomy for sciatica [IPG556]. 2016; https://www.nice.org.uk/guidance/ipg556. Accessed May 6, 2023.
99. Kreiner DS, Hwang SW, Easa JE, et al. An evidence-based clinical guideline for the diagnosis and treatment of lumbar disc herniation with radiculopathy. Spine J. Jan 2014; 14(1): 180-91. PMID 24239490
100. Chou R, Loeser JD, Owens DK, et al. Interventional therapies, surgery, and interdisciplinary rehabilitation for low back pain: an evidence-based clinical practice guideline from the American Pain Society. Spine (Phila Pa 1976). May 01 2009; 34(10): 1066-77. PMID 19363457
101. Sayed D, Grider J, Strand N, et al. The American Society of Pain and Neuroscience (ASPN) Evidence-Based Clinical Guideline of Interventional Treatments for Low Back Pain. J Pain Res. 2022; 15: 3729-3832. PMID 36510616