Observational Study

Risk Factors for Early Recurrence After Transforaminal Endoscopic Lumbar Disc Decompression

Chan Hong Park, MD, PhD, Eun Soo Park, MD, Sang Ho Lee, MD, PhD, Kyung Kyu Lee, MD, Yoon Kwang Kwon, MD, Min Soo Kang, MD, Shin Young Lee, MD, and Young Hwan Shin, MD, PhD

From: Daegu Wooridul Spine Hospital, Jung-Gu, Daegu, Republic of Korea

Address Correspondence: Chan Hong Park, MD, PhD Daegu Wooridul Spine Hospital, 648 Gukchaebosang-Ro, Jung-Gu, Daegu, 41939, Republic of Korea
E-mail: magary1@hanmail.net

Disclaimer: There was no external funding in the preparation of this manuscript. Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 08-03-2018
Accepted for publication: 10-15-2018

Free full manuscript: www.painphysicianjournal.com

Background: Transforaminal endoscopic lumbar disc decompression (TELD) has emerged as a treatment alternative to open lumbar discectomy, but rates of herniated lumbar disc (HLD) recurrence after TELD are higher by comparison.

Objectives: We conducted this study to identify factors correlating with early HLD recurrence after TELD.

Study Design: Retrospective study.

Setting: The Department of Anesthesiology and Pain Medicine, Neurosurgery at Spine Health Wooridul Hospital.

Methods: As a retrospective review, we examined all patients undergoing TELD between 2012 and 2017, analyzing the following in terms of time to recurrence: age, gender, body mass index (BMI), comorbid conditions (diabetes mellitus [DM], hypertension [HTN]), smoking status, nature of disc herniation (central, paramedian, or foraminal), Modic changes, migration grade (rostral vs. caudal track + degree), herniated disc height (Dht) and base size (Dbase), and the presence of spondylolisthesis on magnetic resonance imaging.

Results: During the 5-year study period, 1,900 patients underwent TELD procedures, resulting in 209 recurrences (11.0%). In 27 of these patients (12.9%), herniation recurred within 24 hours after surgery. Recurrences most often developed within 2-30 days (n = 76). The smaller the size of a herniated disc, the earlier it recurred. Recurrences were unrelated to gender, BMI, DM or HTN, smoking status, migration grade, nature (Dht or Dbase of herniated disc), or the presence of spondylolisthesis.

Limitations: In addition to variables assessed herein, other clinical and radiologic parameters that may be important in recurrent disc herniation should be included. Furthermore, only univariate analyses were performed, making no adjustments for potential confounders, therefore, independent risk factors could not be assessed. A prospective study would likely generate more precise results, especially in terms of standardized sampling and data classification. Finally, multiple causes for primary discectomy failures may have rendered our patient groups nonhomogeneous, and inequalities in surgical options or physician-dictated surgical choices may have had an effect.

Conclusions: In patients undergoing TELD procedures, smaller-sized herniated discs are linked to early recurrences.

Key words: Disc herniation, lumbar, endoscopic, recurrence, early

Pain Physician 2019: 22:E133-E138

Transforaminal endoscopic lumbar disc decompression (TELD) is a minimally invasive spinal procedure for treatment of herniated lumbar disc (HLD) (1-3). Compared with open lumbar discectomy (OLD), TELD has several advantages and some disadvantages (3-5). The advantages include less chance of paravertebral muscle injury, no undermining of bony structures, shorter operation times and hospital stays, and reduced blood loss (3-5). Despite such benefits, multiple sources have shown that reoperation rates after TELD have exceeded those determined for OLD (4,6-8). Various patient-related factors, such as age, gender, cigarette smoking, hypertension (HTN), and degree of herniation have also been implicated in recurrent disc herniation (9-16). However, at least one contradictory study suggests that recurrences bear no relation to patient age, gender, smoking status, extent of herniation, or symptom duration (17).

Risk factors for recurrence after partial laminectomy and discectomy have been researched on occasion (11,17), but few studies have addressed factors impacting recurrence rates after TELD. This study served to identify factors involved in HLD recurrences after TELD procedures, especially early (i.e., 24-hour) recurrences.

Methods

Patient Population

Between January 2012 and December 2017, patients undergoing TELD for HLD totaled 1,900, with 209 of them developing recurrences. In all instances of recurrence, patients had shown successful HLD removal in magnetic resonance imaging (MRI) studies obtained for immediate postoperative assessment. Once the pain recurred, a third MRI was performed, documenting disc herniation at the same level and in the same manner. Second operations were then necessitated.

Surgical Procedure

All TELD procedures were carried out in the prone position under local anesthesia. The cutaneous entry point was generally situated ~8-13 cm from midline (in accord with trajectory), determined by a patient's body size, the site of herniation, and foraminal dimensions. Once infiltrated by lidocaine (1%), we introduced an 18-gauge spinal needle under fluoroscopic guidance, advancing its tip along a perpendicular line running medial to lateral in anteroposterior projection to a point posterior to the vertebral column in lateral projection.

An epidurogram was subsequently performed, injecting contrast media to confirm exiting and traversing root locations. With the spinal needle lodged in the disc, we then stained the nucleus pulposus blue (using a 1-mL admixture of contrast media and indigo carmine for discography) and proceeded with the following steps: 1) guidewire passage through spinal needle; 2) removal of spinal needle; 3) limited incision of skin at entry site; 4) delivery of tapered cannulated obturator along guidewire; 5) forcible insertion of obturator into disc (on reaching annulus); 6) advancement of bevel-ended, oval-shaped working cannula (into disc) along obturator; and 7) obturator removal.

Next, an endoscope was passed through the cannula, and the pathologic nucleus (stained blue for easy distinction and attached to annular fissure) and any fibrous scar tissue were released and completely removed using endoscopic forceps and a radiofrequency device. When complete, the endoscope was withdrawn and the skin was sutured.

Study Terms and Parameters

Recurrence was defined as same-level, same-sided radiographic evidence of disc herniation, despite immediate postoperative documentation that all extruded fragments were completely removed. Such comparisons were achieved by chart review, assessing pre- and postoperative MRI scans.

Variables analyzed in all patients included age, gender, body mass index (BMI), comorbid conditions (diabetes mellitus [DM], HTN), smoking status, nature of disc herniation (central, paramedian, or foraminal), Modic changes (MCs), migration grade (rostral vs. caudal track + degree), herniated disc height (Dht) and base size (Dbase), and presence of spondylolisthesis on MRI. Central, paramedian, or foraminal herniation signaled positioning relative to pedicle and spinal canal. Migrating herniated disc fragments were graded as follows: very high rostral (R3), high rostral (R2), low rostral (R1), low caudal (C1), high caudal (C2), or very high caudal (C3) (18). MCs were classified as type I (hypointense signal on T1-weighted imaging [T1WI] and hyperintense signal on T2-weighted imaging [T2WI]); type II (hyperintense signals on T1WI and T2WI); or type III (hypointense signals on T1WI and T2WI).

Statistical Analysis

All factors were analyzed relative to time of recurrent herniation. As statistical measures, the independent t test, the chi-square test, the Fisher exact test, and

the univariate logistic regression were applied, setting significance at $P < 0.05$.

Results

Between 2012 and 2017, a total of 1,900 patients underwent TELD procedures, resulting in 209 (11%) recurrent herniations. Patient characteristics are summarized in Table 1. Recurrences accruing at < 24 hours, 2-30 days, 31-90 days, 90-365 days, and > 365 days totaled 27, 76, 52, 38, and 16 , respectively. In terms of time to recurrence, the mean was 112 days (range, 1-941 days) (Table 1). Recurrence most often occurred within 2-30 days. There were 119 patients (56.9%) with HLDs at L4-L5 level, compared with 43 patients (20.6%) at L5-S1.

A small-sized disc base emerged as a significant factor in early recurrence ($P < 0.05$) (Table 2). Age, gender, DM, HTN, smoking status, BMI, nature of disc herniation, MCs, migration grade, Dht of herniated disc, and the presence of spondylolisthesis did not impact the timing of recurrences (Table 2).

Table 1. *Patient characteristics*.

n = 209	Patients Characteristics
Age (yrs)	49.7 ± 14.8
Gender (M : F)	130 (61.9%) : 79 (37.6%)
Weight (kg)	69.1 ± 12.3
Height (cm)	169.1 ± 42.2
Surgery location	
T12-L1	1
L1-2	1
L2-3	10
L3-4	14
L4-5	119
L5-S1	43
Number of patients	
< 24 hours	27
2-30 days	76
31-90 days	52
90-365 days	38
< 365 days	16

Discussion

In the present study, 209 of 1,900 patients (11%) experienced HLD recurrences after TELD; and the dimensions of a herniated disc base proved to be a significant factor, correlating with early recurrence. Recurrent herniation was the most common cause of reoperation and is known to occur in 0.8%-15% of patients treated surgically for primary HLD (7,17,19). Remnants of surgically unappreciated disc fragments and incomplete decompression may lead to higher rates of early recurrences. To reduce this likelihood, it is essential to remove all culpable elements, both basal segments and extruded parts (8).

Although our data are not in agreement, age has been identified as an influential factor in HLD recurrences (9-12). Some researchers maintain that younger age and male gender constitute risk factors for recurrent disc herniation (11,12), whereas age and gender have been discounted by others (11,20,21), and found to be similar in patients with and without recurrences after open or microdiscectomy (13,22,23). Our data showed no significant relation between gender and recurrent HLD, as did one earlier investigation reporting a lack of gender differences in this setting (10,24).

Surprisingly, the present study revealed a correlation between a smaller-sized herniated Dbase and early recurrence. We had presumed that larger size would predispose to earlier recurrence, given the greater surgical void of annulus produced. Instead, the opposite was observed. Further study may therefore be warranted in this regard.

Existing MCs have also been implicated in herniated disc recurrences (16,25,26). Patients demonstrating higher preoperative disc heights and MCs may be at greater risk, tending to experience recurrences (25). The plausible explanation is resultant instability.

Although BMI and many of the variables we analyzed (DM, HTN, nature of herniation, migration grade, Dht, and presence of spondylolisthesis) failed to correlate with HLD recurrences, BMI and obesity are reportedly influential (16,23,26). Moliterno et al (13) have determined that relatively lower BMI values bear a significant association with herniated disc recurrence. However, Kara et al (27) have established that BMI and recurrences are unrelated, just as our evidence suggests.

Smoking has been shown by others to be predictive of herniated disc recurrence (14,28-30). Kim et al (29) have found smoking, degenerative disc disease, and recurrence to be interrelated, yet the mechanism by which smoking contributes to disc degeneration is not entirely understood (31), and a link to herniated disc recurrence is doubted by some (22,23,27).

HTN is a significant and independently associated factor in symptomatic lumbar disc herniation (32), owing to occlusion of small-caliber vessels arising from

Table 2. *Analysis of variance of the demographics and radiologic characteristics according to recurrence time for the recurrence group.*

n = 209	Recurrence Time Course					
	< 24 hrs (n = 27)	2-30 days (n = 76)	31-90 days (n = 52)	90-265 days (n = 38)	< 365 days (n = 16)	*P* value
Age (yrs)	52.5 ± 15.9	49.8 ± 15.0.8	48.7 ± 16.7	50.6 ± 12.3	46.1 ± 10.8	0.80
Gender (M : F)	19 : 8	49 : 27	30 : 22	20 ; 18	12 : 4	
Body mass index (kg/m^2)	24.5 ± 3.0	24.5 ± 4.0	24.2 ± 6.3	23.9 ± 5.2	25.7 ± 4.0	0.82
Diabetes mellitus						0.49
Yes	2	6	7	7	4	
No	22	70	43	31	12	
Smoking						0.71
Yes	9	57	17	10	9	
No	18	19	35	28	7	
Hypertension						0.64
Yes	5	20	9	7	4	
No	22	56	43	31	12	
Herniation location						0.64
Central	6	19	13	15	1	
Paramedian	21	53	38	22	15	
Foraminal	0	4	1	1	0	
Modic change						0.91
0	11	42	26	14	8	
1	4	6	5	7	2	
2	12	28	21	16	6	
3	0	0	0	0	0	
Migration						0.85
Rostral 3	0	5	1	1	0	
Rostral	0	3	0	0	1	
Rostral	2	5	1	2	2	
0	6	26	22	12	4	
Caudal	13	29	18	19	9	
Caudal	5	6	9	3	0	
Caudal	1	2	1	1	0	
Herniated disc base (mm)	13.1 ± 3.5	15.3 ± 5.8	16.3 ± 5.5	16.8 ± 4.8	16.5 ± 5.3	0.04
Disc height (mm)	9.1 ± 1.7	9.4 ± 1.8	9.0 ± 1.4	9.8 ± 3.0	9.6 ± 2.0	
Spondylolisthesis						0.59
No	24	66	41	34	13	
Yes (cm)	0.3 ± 0.9	0.5 ± 1.3 (2-6)	0.70± 1.5	0.3 ± 0.9	0.6 ± 1.3	

distal aorta (32), and disc migration seems to impact recurrence as well. In a group of patients with high (vs. lower) grades of migration, the incidence of surgical failures proved significantly greater. Consequently, open surgery may well be considered for disc herniation with high-canal compromise or high-grade migration (15).

This study has certain limitations. In addition to variables assessed herein, other clinical and radiologic parameters (i.e., canal diameter, facet angle, and annular defect size) that may be important in recurrent disc herniation should be included. Furthermore, only

univariate analyses were performed, making no adjustments for potential confounders, so independent risk factors could not be assessed. A prospective study would likely generate more precise results, especially in terms of standardized sampling and data classification. Finally, multiple causes for primary discectomy failures may have rendered our patient groups nonhomogeneous, and inequalities in surgical options or physician-dictated surgical choices may have come into play. Nevertheless, this study sets the stage for future efforts to expand our knowledge of HLD recurrence rates and factors impacting early recurrence after single-level TELD.

Completeness of removal is critical TELD procedures performed on smaller-sized herniated discs, which are prone to early recurrences.

References

1. Smith N, Masters J, Jensen C, Khan A, Sprowson A. Systematic review of microendoscopic discectomy for lumbar disc herniation. *Eur Spine J* 2013; 22:2458-2465.
2. Choi G, Pophale CS, Patel B, Uniyal P. Endoscopic spine surgery. *J Korean Neurosurg Soc* 2017; 60:485-497.
3. Li X, Han Y, Di Z, Cui J, Pan J, Yang M, Sun G, Tan J, Li L. Percutaneous endoscopic lumbar discectomy for lumbar disc herniation. *J Clin Neurosci* 2016; 33:19-27.
4. Ruan W, Feng F, Liu Z, Xie J, Cai L, Ping A. Comparison of percutaneous endoscopic lumbar discectomy versus open lumbar microdiscectomy for lumbar disc herniation: A meta-analysis. *Int J Surg* 2016; 31:86-92.
5. Cong L, Zhu Y, Tu G. A meta-analysis of endoscopic discectomy versus open discectomy for symptomatic lumbar disk herniation. *Eur Spine J* 2016; 25:134-143.
6. Kim CH, Chung CK, Park CS, Choi B, Hahn S, Kim MJ, Lee KS, Park BJ. Reoperation rate after surgery for lumbar spinal stenosis without spondylolisthesis: A nationwide cohort study. *Spine J* 2013; 13:1230-1237.
7. Choi KC, Lee JH, Kim JS, Sabal LA, Lee S, Kim H, Lee SH. Unsuccessful percutaneous endoscopic lumbar discectomy: A single-center experience of 10,228 cases. *Neurosurgery* 2015; 76:372-380; discussion 380-371; quiz 381.
8. Cheng J, Wang H, Zheng W, Li C, Wang J, Zhang Z, Huang B, Zhou Y. Reoperation after lumbar disc surgery in two hundred and seven patients. *Int Orthop* 2013; 37:1511-1517.
9. Ahn Y, Lee SH, Park WM, Lee HY, Shin SW, Kang HY. Percutaneous endoscopic lumbar discectomy for recurrent disc herniation: Surgical technique, outcome, and prognostic factors of 43 consecutive cases. *Spine (Phila Pa 1976)* 2004; 29:E326-E332.
10. Dai LY, Zhou Q, Yao WF, Shen L. Recurrent lumbar disc herniation after discectomy: Outcome of repeat discectomy. *Surg Neurol* 2005; 64:226-231; discussion 231.
11. Suk KS, Lee HM, Moon SH, Kim NH. Recurrent lumbar disc herniation: Results of operative management. *Spine (Phila Pa 1976)* 2001; 26:672-676.
12. Cinotti G, Gumina S, Giannicola G, Postacchini F. Contralateral recurrent lumbar disc herniation. Results of discectomy compared with those in primary herniation. *Spine (Phila Pa 1976)* 1999; 24:800-806.
13. Moliterno JA, Knopman J, Parikh K, Cohan JN, Huang QD, Aaker GD, Grivoyannis AD, Patel AR, Hartl R, Boockvar JA. Results and risk factors for recurrence following single-level tubular lumbar microdiscectomy. *J Neurosurg Spine* 2010; 12:680-686.
14. An HS, Silveri CP, Simpson JM, File P, Simmons C, Simeone FA, Balderston RA. Comparison of smoking habits between patients with surgically confirmed herniated lumbar and cervical disc disease and controls. *J Spinal Disord* 1994; 7:369-373.
15. Lee SH, Kang BU, Ahn Y, Choi G, Choi YG, Ahn KU, Shin SW, Kang HY. Operative failure of percutaneous endoscopic lumbar discectomy: A radiologic analysis of 55 cases. *Spine (Phila Pa 1976)* 2006; 31:E285-E290.
16. Kim JM, Lee SH, Ahn Y, Yoon DH, Lee CD, Lim ST. Recurrence after successful percutaneous endoscopic lumbar discectomy. *Minim Invasive Neurosurg* 2007; 50:82-85.
17. Swartz KR, Trost GR. Recurrent lumbar disc herniation. *Neurosurg Focus* 2003; 15:E10.
18. Ahn Y, Jeong TS, Lim T, Jeon JY. Grading system for migrated lumbar disc herniation on sagittal magnetic resonance imaging: An agreement study. *Neuroradiology* 2018; 60:101-107.
19. Kim MJ, Lee SH, Jung ES, Son BG, Choi ES, Shin JH, Sung JK, Chi YC. Targeted percutaneous transforaminal endoscopic diskectomy in 295 patients: Comparison with results of microscopic diskectomy. *Surg Neurol* 2007; 68:623-631.
20. Carragee EJ, Han MY, Suen PW, Kim D. Clinical outcomes after lumbar discectomy for sciatica: The effects of fragment type and anular competence. *J Bone Joint Surg Am* 2003; 85-A:102-108.
21. Mobbs RJ, Newcombe RL, Chandran KN. Lumbar discectomy and the diabetic patient: Incidence and outcome. *J Clin Neurosci* 2001; 8:10-13.
22. Palma L, Carangelo B, Muzii VF, Mariottini A, Zalaffi A, Capitani S. Microsurgery for recurrent lumbar disk herniation at the same level and side: Do patients fare worse? Experience with 95 consecutive cases. *Surg Neurol* 2008; 70:619-621; discussion 621.
23. Meredith DS, Huang RC, Nguyen J, Lyman S. Obesity increases the risk of recurrent herniated nucleus pulposus

after lumbar microdiscectomy. *Spine J* 2010; 10:575-580.

24. Keskimaki I, Seitsalo S, Osterman H, Rissanen P. Reoperations after lumbar disc surgery: A population-based study of regional and interspecialty variations. *Spine (Phila Pa 1976)* 2000; 25:1500-1508.
25. Yaman ME, Kazanci A, Yaman ND, Bas F, Ayberk G. Factors that influence recurrent lumbar disc herniation. *Hong Kong Med J* 2017; 23:258-263.
26. Heindel P, Tuchman A, Hsieh PC, Pham MH, D'Oro A, Patel NN, Jakoi AM, Hah R, Liu JC, Buser Z, Wang JC. Reoperation rates after single-level lumbar discectomy. *Spine (Phila Pa 1976)* 2017; 42:E496-E501.
27. Kara B, Tulum Z, Acar U. Functional results and the risk factors of reoperations after lumbar disc surgery. *Eur Spine J* 2005; 14:43-48.
28. Kelsey JL. An epidemiological study of the relationship between occupations and acute herniated lumbar intervertebral discs. *Int J Epidemiol* 1975; 4:197-205.
29. Kim KT, Park SW, Kim YB. Disc height and segmental motion as risk factors for recurrent lumbar disc herniation. *Spine (Phila Pa 1976)* 2009; 34:2674-2678.
30. Kelsey JL, Githens PB, O'Conner T, Weil U, Calogero JA, Holford TR, White AA 3rd, Walter SD, Ostfeld AM, Southwick WO. Acute prolapsed lumbar intervertebral disc. An epidemiologic study with special reference to driving automobiles and cigarette smoking. *Spine (Phila Pa 1976)* 1984; 9:608-613.
31. Stairmand JW, Holm S, Urban JP. Factors influencing oxygen concentration gradients in the intervertebral disc. A theoretical analysis. *Spine (Phila Pa 1976)* 1991; 16:444-449.
32. Jhawar BS, Fuchs CS, Colditz GA, Stampfer MJ. Cardiovascular risk factors for physician-diagnosed lumbar disc herniation. *Spine J* 2006; 6:684-691.