International Orthopaedics (2020) 44:2357–2363
https://doi.org/10.1007/s00264-020-04656-0

ORIGINAL PAPER

Does anxiety influence the prognosis of percutaneous transforaminal endoscopic discectomy in the treatment of lumbar disc herniation? A preliminary propensity score matching analysis

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Received: 25 December 2019 / Accepted: 2 June 2020 / Published online: 11 June 2020

Abstract

Purpose Previous reports revealed a correlation between psychological problems and spinal surgery. There is a lack of knowledge on the effect of anxiety on the percutaneous transforaminal endoscopic discectomy (PTED) outcome at the two year follow-up. The purpose of this study is to investigate changes in anxiety after PTED among patients with lumbar disc herniation (LDH), to compare the effect of anxiety on the prognosis using propensity score matching analysis, and to identify the related parameters of anxiety.

Methods A total of 145 patients with LDH requiring PTED surgery were included. Twenty-six LDH patients with anxiety were matched with 26 control patients utilizing propensity score matching analysis. The demographic and peri-operative data were collected and analyzed. A correlation analysis was utilized.

Results Both groups achieved significant improvements in visual analogue scale (VAS) scores for pain, Japanese Orthopedic Association (JOA) scores for neurological deficit, and 36-item Short-Form Health Survey (SF-36) scores and Oswestry Disability Index (ODI) scores for quality of life. A statistical difference was detected between the pre-operative and the post-operative Zung Self-Rating Anxiety Scale scores in the anxiety cohort. However, the difference between the anxiety group and the control group was statistically significant in the aforementioned parameters. The VAS, JOA, ODI and the SF-36 scores, and the disease duration were associated with pre-operative anxiety.

Conclusion PTED may provide significant improvements in clinical outcomes and symptoms of anxiety. A negative impact on the patient's prognosis may be caused by the presence of anxiety. Pain severity, neurological deficit, disease duration, and quality of life were associated with anxiety.

Keywords Percutaneous transforaminal endoscopic discectomy · Lumbar disc herniation · Anxiety · Prognosis · Pain · Life quality · Related factors

Introduction

Percutaneous transforaminal endoscopic discectomy (PTED) is a remarkably emerging technology for the alternative treatment of lumbar disc herniation (LDH) [1]. Meanwhile, PTED is considered as an alternative to open discectomy with or without fusion surgery, owing to minimal skin incision, less muscular injury, maximal preservation of bone structure, minimal blood loss, shorter operative time, and early return to normal daily life. Recently, several investigations have emphasized mostly on the indications and contradictions for PTED [2, 3], on new design available for clinical utilization [4, 5], on the comparison with other techniques [6], and on complications.

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Anxiety is a psychological disturbance that is usually associated with chronic disorders, particularly chronic pain, which a variety of patients with LDH have suffered from. Currently, several studies have revealed that the overall prevalence of anxiety in patients with musculoskeletal diseases is high, ranging from 30 to 60% [7]. Additionally, several investigations highlighted the importance of the mental state which is a vital signal of the health condition for patients with lumbar disc degenerative disease [8]. D'Angelo et al. reported that the anxiety status was closely related to functional disability and pain intensity [9]. Moreover, other researchers also found a higher prevalence of anxiety in the low back pain patients [10–12]. Apart from other pre-operative factors, increasing evidence indicates that the difference documented in the results after spinal operation might be partially attributed to the pre-operative psychological status. It is also revealed in the patients who underwent cervical surgical treatments. Furthermore, PTED is an unusually challenging procedure because of the requirement of relatively long learning curve and rich clinical experience in open discectomy. To date, the assessment of pre-operative anxiety, the post-operative improvements in anxiety, and the importance of pre-operative anxiety on the prognosis involving the PTED treatment have not been thoroughly investigated. Undeniably, observational studies usually show relevance between baseline distributions across groups. Thus, propensity score matching is an effective approach to balance the differences in the confounding factors across groups, and may still not affect the results for a specific event [13].

The present study attempts to assess the changes in anxiety after PTED, to determine the related risk factors affecting the patient's psychological state, and to compare the effect of anxiety on the outcome of PTED after propensity score matching, hence emphasizing the importance of reminding spine surgeons to take into account the patients' psychological condition prior to the operation procedure.

Materials and methods

Patient population

After obtaining approval from local institutional review board and written informed consent from all patients, 145 consecutive patients with single-level lumbar disc herniation (LDH) undergoing PTED in our department between May 2016 and June 2017 were included in this study. All the patients were presented with characteristic symptoms and signs of LDH, aged between 18 and 60 years, and were refractory to conservative therapy for more than three months.

The following patients were excluded: (1) those for which the reason of the symptoms was trauma, infection, or neoplasm; (2) those who suffered from lumbar canal stenosis, lumbar instability, bilateral symptoms, or could not undergo PTED; (3) those whose operative levels were not L4/5, L5/S1, or multilevel; (4) those who had psychiatric problems (such as schizophrenia and severe depression) or cognitive impairment; (5) those who had a previous surgical history; or (6) were unable to complete the follow-up or received specific treatment for anxiety on a regular basis. All patients had received the radiograms, computed tomography, and magnetic resonance images of the lumbar spine.

The included patients were stratified strictly into 2 groups according to the scores of Zung Self-Rating Anxiety Scale (SAS) [14]: a control cohort whose score was lower than 50, and the anxiety cohort including the other subjects.

Clinical assessment

The peri-operative pain intensity, disability severity, and quality of life were evaluated via the outpatient questionnaires or a phone interview scheduled by an independent investigator not related to this study. The visual analogue scale (VAS), Japanese Orthopedic Association (JOA), the 36-item Short-Form (SF-36) health survey [15], Oswestry Disability Index (ODI), and SAS were listed in the questionnaires.

The SAS scores were utilized to evaluate the degrees of anxiety, which include 20 items with favourable reliability and validity, assessing the basic features of anxiety. SAS scores ranging from 50 to 59 suggest "slight anxiety," 60 to 69 suggest "moderate anxiety," and more than 70 suggest "severe anxiety."

Sample size analysis

A sample size analysis was performed for the present study. VAS was utilized as the outcome variable. In view of 5% marginal error and 80% power, a power analysis suggested that a minimum size of 18 subjects was required for each group to investigate the difference in VAS between both groups. The analysis was calculated utilizing the G*Power software (version 3.1.9.2).

Statistical analysis

The analysis making use of propensity score matching is generally performed in retrospective cohort studies to adjust for known confounding biases. The procedure for this analysis was calculated by SPSS version 22.0 (IBM Statistics, New York, USA). Anxiety and control cases were matched based on propensity score with the caliper lower than 0.02, and anxiety and control patients were then matched using a 1:1 nearest neighbor matching method. Multivariate analysis was applied to verify covariates that may influence the outcome. Standardized differences were utilized to compare baseline characteristics between the two groups. Significant

differences were found between those two groups relating to age ($P = 0.003$), gender ($P = 0.039$), and segment distribution ($P = 0.028$). The post-matching balance of related baseline covariates was re-assessed (Table 1). Before and after matching, continuous and categorical values between both groups were compared using *t* test or Chi-square test, respectively. Correlations among the SAS score with the related factors were analyzed through a correlation analysis. *P* value < .05 was considered statistically significant.

Results

Patient characteristics

For the initial data, 145 eligible patients were recruited. Of the 145 patients, 106 complied with the inclusion criteria: 34 with the anxiety symptom and 72 without it. At baseline, there were statistical differences between both groups with regard to demographic characteristics. After propensity-score matching, the anxiety cohort and the control cohort each included 26 patients (Fig. 1). No significant differences between the 2 groups in clinical and demographic characteristics were detected, showing a successful matching process (Table 1).

Results in the propensity-matched cohorts

Pre-operatively, there were ten (38.5%) patients suffering from mild anxiety and 16 (61.5%) patients suffering from moderate anxiety in the anxiety cohort. There were statistical improvements in the pain and disability for all patients at the final follow-up after PTED operation in each cohort ($P < 0.05$). The clinical results are shown in Fig. 2. For the patients with anxiety, significant improvements were noted between the pre-operative and the two year post-operative VAS (leg pain and low back pain) scores ($P < 0.05$), the SF-36 scores, ODI scores, JOA scores, and SAS scores ($P < 0.05$). Similarly, a significant increase in the aforementioned scores two years after the surgery was also observed in the control group ($P < 0.05$). Although significant improvements in pain, functional activity, neurological condition, and psychological state have been achieved in the two groups at each post-operative follow-up, there were still statistical differences in the terms of VAS (leg pain and low back pain) scores, SF-36 mental scores, ODI scores, and SAS scores between the 2 groups during follow-up($P < 0.05$).

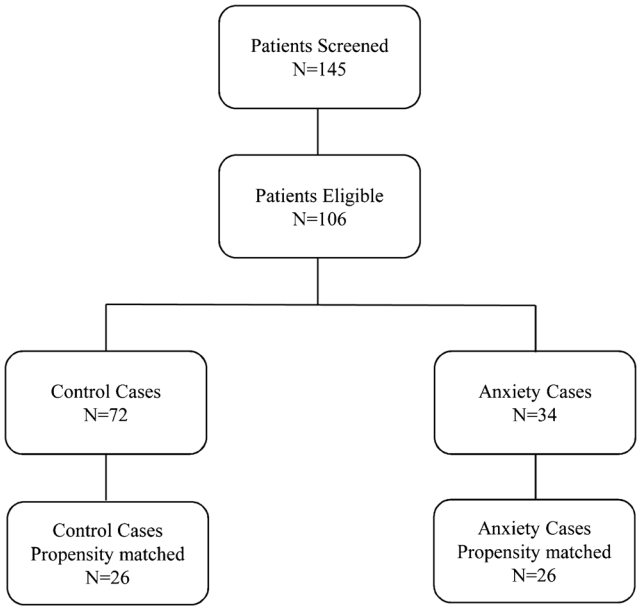

Fig. 1 Eligible patients and those included in propensity-score matching

The peri-operative data are summarized in Table 2. There was no statistical difference between the two groups in terms of operation time and intra-operative blood loss ($P > 0.05$). Pre-operative JOA (leg pain and low back pain) score, pre-operative SF-36 (physical and mental) score, pre-operative ODI score, and pre-operative SAS score in both groups demonstrated significant differences ($P < 0.05$). No complication was documented in either groups ($P > 0.05$).

Correlation between pre-operative anxiety and related parameters

Among the matched patients, the disease duration, the degree of pain (the VAS score), the level of neurological deficit (the JOA score), and the quality of life (the SF-36 score and ODI

Table 1 Baseline characteristics of patients before and after propensity score matching

	All cases		*P*	Matched cases		*P*
Parameters	Control cases $N = 72$	Anxiety cases $N = 34$		Control cases $N = 26$	Anxiety cases $N = 26$	
Age, year	37.19 ± 9.42	42.82 ± 7.65	0.003	41.12 ± 7.24	41.04 ± 7.25	0.970
Gender (M/F)	47/25	15/19	0.039	12/14	13/13	0.786
BMI, kg/m^2	24.71 ± 3.24	24.45 ± 3.55	0.713	24.95 ± 3.77	24.86 ± 3.51	0.928
Segment (L4-L5/L5-S1)	46/26	14/20	0.028	15/11	14/12	0.785

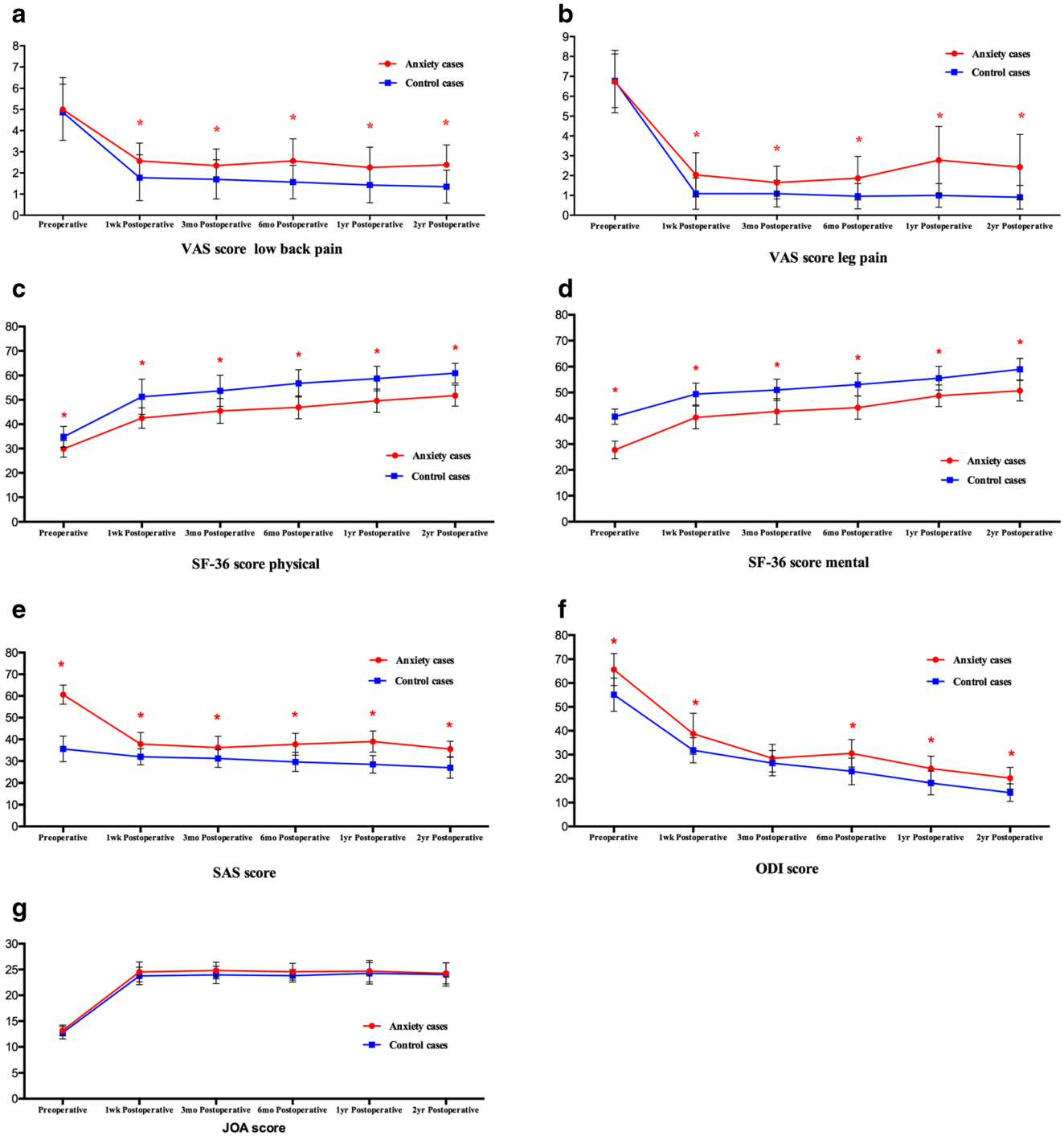

Fig. 2 Line graphs showing a comparison of VAS, SF-36, ODI, and SAS scores between anxiety cases and control cases. Change in trend of VAS-low back pain (**a**); change in trend of VAS-leg pain (**b**); change in trend of SF-36-physical (**c**); change in trend of SF-36-mental (**d**); change in trend of SAS (**e**); change in trend of ODI (**f**); change in trend of JOA (**g**); VAS, SF-36, ODI, JOA, and SAS scores had significantly improved for all patients. *$P < 0.05$ between 2 groups. VAS indicates visual analogue scale; SF-36, 36-item Short-Form Health Survey; Oswestry disability index, ODI; Japanese Orthopedic Association, JOA; SAS, Zung Self-Rating Anxiety Scale

score) were related to the pre-operative level of anxiety (the SAS score) in the correlation analysis. However, age, gender, BMI, and segment distribution had no significant impact on the degree of anxiety. The results indicated that disease duration, VAS score, JOA score, SF-36 score, and ODI score were closely linked to the SAS score (Table 3).

Table 2 Pre-operative parameters after propensity score matching

Parameters	Control cases	Anxiety cases	*P*
Operation time, min	119.50 ± 12.64	117.62 ± 9.77	0.550
Intra-operative blood loss, ml	10.08 ± 3.37	10.81 ± 2.71	0.393
Duration, months	10.81 ± 5.03	24.38 ± 6.33	< 0.001
VAS score low back pain	4.12 ± 1.51	5.15 ± 1.22	0.009
VAS score leg pain	6.04 ± 1.00	6.69 ± 1.19	0.037
SF-36 score physical	32.81 ± 3.67	30.38 ± 3.42	0.017
SF-36 score mental	40.69 ± 3.08	27.92 ± 3.53	< 0.001
ODI score	54.92 ± 6.72	65.46 ± 6.31	< 0.001
JOA score	12.77 ± 1.21	13.19 ± 1.06	0.186
SAS score	35.12 ± 5.65	60.62 ± 3.92	< 0.001

SAS Zung Self-Rating Anxiety Scale, *VAS* visual analogue scale, *SF-36* 36-item Short-Form Health Survey, *ODI* Oswestry Disability Index, *JOA* Japanese Orthopedic Association

Discussion

PTED has become a well-accepted minimally invasive treatment for LDH as a result of the advancement in endoscopic equipments [16]. However, it was found that some patients did not achieve the excellent improvements in the symptoms and the prognosis as expected through PTED surgery in our clinical practice. These inconsistencies have led us to assess the psychopathological profile of patients independently influencing the outcomes. A matter of debate in relation to anxiety has less frequently been investigated despite growing evidence of its basic implication on the clinical outcomes. Anxiety is a psychological disturbance relevantly influencing PTED because the existence and the degree of pre-operative psychological disturbance have independently been associated with a significantly poor response to operation. Previous investigations have indicated that there is a connection between psychological disorders and lumbar surgery, cervical surgery [17], or chronic spinal pain [18, 19]. Nonetheless, there is a great disparity in our cognition of the relationship between anxiety and PTED. In the current study, 38.5% of patients presented mild anxiety while 61.5% of patients had moderate anxiety. Even though PTED is a relatively novel surgery with undeniable advantage, pre-operative anxiety may still be present and affect the success of the operation. Given retrospective analysis in nature with lack of a comparable matched control group, the propensity score matching method was applied to compare the clinical outcomes between anxiety and control patients by PTED procedure. The propensity score is a balancing score that enables us to make the distribution of the measured baseline variables similar between the groups.

Table 3 Correlations between SAS score and pre-operative-related factors after propensity score matching

Parameters	SAS score	
	r	*P*
Age	− 0.070	0.622
Gender	0.032	0.821
BMI	0.065	0.647
Duration	0.757	< 0.001
Segment	− 0.079	0.579
VAS score low back pain	0.457	0.001
VAS score leg pain	0.478	< 0.001
SF-36 score physical	− 0.460	0.001
SF-36 score mental	− 0.737	< 0.001
ODI score	0.610	< 0.001
JOA score	0.339	0.014

SAS Zung Self-Rating Anxiety Scale, *VAS* visual analogue scale, *SF-36* 36-item Short-Form Health Survey, *ODI* Oswestry Disability Index, *JOA* Japanese Orthopedic Association

The effect of anxiety on the prognosis

This study revealed that the patients with anxiety achieved significant improvement in the pain and quality of life after the PTED treatment, while psychopathological scores decreased rapidly. These changes may strongly be linked to the extent of relief in pain and disability. However, the clinical outcomes in the anxiety cohort were still inferior to those in the control cohort. One possible interpretation for the phenomenon might be pre-operative anxiety and pain intensity. Previously, a clinically related connection between anxiety sensitivity and pain magnitude was found [20, 21], which suggests a strong interplay between pre-operative mental status and patient-reported outcome after PTED. Moreover, Dunn et al. also reported that pre-operative anxiety may play an essential role in regulating post-operative pain, and earlier, psychotherapy can decrease pain magnitude significantly [22]. Another possible reason may be the influence of disease duration and pain chronicity. Anecdotally, a prolonged duration of symptoms is often related to a poor prognosis for recovery. It is also proposed that persistently activated peripheral nociceptors might finally result in the neural plasticity, over a specified duration, in either the central nervous system ("central sensitization") or the dorsal root ganglions ("peripheral sensitization") [23, 24]. Apart from a continuous severity of pain, it may be elucidated that a significantly prolonged disease duration would be required for plastic changes. Moreover, D'Angelo suggested that the pre-operative presence of anxiety is a prognostic indicator for the post-operative persistence of pain [9]. Along with the complexity of the nervous system and the regulating mechanisms of pain, additional attention to psychological status should be paid.

Risk factors for pre-operative anxiety

Our results after adjustment by propensity score showed a strong relationship between the status of anxiety and the disease duration, the level of pain (the VAS scores), neurological deficits (the JOA scores), and the quality of life (the SF-36 scores and ODI scores). These findings, which demonstrate that pain, low quality of life, and disease duration were associated with anxiety, are similar to those of previous studies. The relationship between the mood condition and pain has not been comprehensively elucidated. Heikkinen et al. revealed a major correlation between the LDH and anxiety [25]. Furthermore, Jess et al. indicated that patients with shorter durations of pain might have relatively superior results in the short term, emphasizing the increased advantage in enrolling patients in the treatment in the early stages [26]. Our results also suggested that long disease duration in the anxiety cohort had poor clinical prognosis than that in the control group. Frequently, LDH with long disease duration may lead to chronic pain and influence the quality of life [27]. Patients experiencing chronic pain and/or neurological deficits often endured several problems that affect daily life, including mental stress, sleep disturbance, and social disaffiliation, indicating that the relationship between anxiety and LDH should be deeper and complete. Notwithstanding, some researchers insisted that early intervention is critical for the efficacy of LDH irrespective of prolonged disease duration.

Limitations

There were naturally some limitations in this study. Despite the statistical methodology employed in this study, the data utilized in the propensity score matching were collected retrospectively and limited to the integrity of our data. Additionally, there is the likelihood of unmeasured confounding socioeconomic factors, such as educational degree, occupational characteristics, insurance, and employment status. Finally, even though it exceeds the size that was estimated based on the preliminary study for detecting a statistical difference of clinical outcome, the sample size for subjects included in the present study might be relatively small. Therefore, further clinical studies with a larger sample size will be necessary.

Conclusion

Our study demonstrated that patients with anxiety achieved significant improvement, while anxiety significantly improved after the PTED operation. Anxiety had a strong correlation with pain, neurological deficit, the quality of life, and disease duration, and had negative effects on the prognosis. Our findings indicated that surgeons should pay extra attention to the anxiety in patients with LDH to not only promote the relief of pre-operative symptoms but also to ameliorate the psychological condition. Early intervention is critical for LDH with anxiety irrespective of disease duration.

Funding information This study was funded by the China Postdoctoral Science Foundation (2019M651588) and Cultivation Program for the National Natural Science Foundation of China from Shanghai Tenth People's Hospital (04. 03. 18. 081).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The manuscript submitted does not contain information about medical device(s)/drug(s). This study was approved by the ethics department of Shanghai Tenth People's Hospital (SHSY-IEC-4.1/20-27/01).

References

1. Chen X, Qin R, Hao J et al (2019) Percutaneous endoscopic decompression via transforaminal approach for lumbar lateral recess stenosis in geriatric patients. Int Orthop 43(5):1263–1269. https://doi.org/10.1007/s00264-018-4051-3
2. Eun SS, Lee SH, Liu WC, Erken HY (2018) A novel preoperative trajectory evaluation method for L5-S1 transforaminal percutaneous endoscopic lumbar discectomy. Spine J 18(7):1286–1291. https://doi.org/10.1016/j.spinee.2018.02.021
3. Tezuka F, Sakai T, Abe M et al (2017) Anatomical considerations of the iliac crest on percutaneous endoscopic discectomy using a transforaminal approach. Spine J 17(12):1875–1880. https://doi.org/10.1016/j.spinee.2017.06.012
4. Kanno H, Aizawa T, Hahimoto K, Itoi E (2019) Minimally invasive discectomy for lumbar disc herniation: current concepts, surgical techniques, and outcomes. Int Orthop 43(4):917–922. https://doi.org/10.1007/s00264-018-4256-5
5. Zhang M, Yan L, Li S et al (2019) Ultrasound-guided transforaminal percutaneous endoscopic lumbar discectomy: a new guidance method that reduces radiation doses. Eur Spine J 28(11):2543–2550. https://doi.org/10.1007/s00586-019-05980-9
6. Nie H, Zeng J, Song Y et al (2016) Percutaneous endoscopic lumbar discectomy for L5-S1 disc herniation via an interlaminar approach versus a transforaminal approach: a prospective randomized controlled study with 2-year follow up. Spine 41(Suppl 19):B30–B37
7. Saravay SM (1996) Psychiatric interventions in the medically ill. Outcome and effectiveness research. Psychiatr Clin North Am 19(3):467–480
8. Mu W, Shang Y, Zhang C, Tang S (2019) Analysis of the depression and anxiety status and related risk factors in patients with lumbar disc herniation. Pak J Med Sci 35(3):658–662. https://doi.org/10.12669/pjms.35.3.299
9. D'Angelo C, Mirijello A, Ferrulli A et al (2010) Role of trait anxiety in persistent radicular pain after surgery for lumbar disc herniation: a 1-year longitudinal study. Neurosurgery 67(2):265–271. https://doi.org/10.1227/01.NEU.0000371971.51755.1C
10. Bener A, Verjee M, Dafeeah EE et al (2013) Psychological factors: anxiety, depression, and somatization symptoms in low back pain patients. J Pain Res 6:95–101. https://doi.org/10.2147/JPR.S40740

11. Tavares C, Salvi CS, Nisihara R, Skare T (2019) Low back pain in Brazilian medical students: a cross-sectional study in 629 individuals. Clin Rheumatol 38(3):939–942. https://doi.org/10.1007/s10067-018-4323-8
12. Oliveira DS, Velia Ferreira Mendonca L, Sofia Monteiro Sampaio R et al (2019) The impact of anxiety and depression on the outcomes of chronic low back pain multidisciplinary pain management-a multicenter prospective cohort study in pain clinics with one-year follow-up. Pain Med 20(4):736–746. https://doi.org/10.1093/pm/pny128
13. Lee HJ, Park YB, Song MK et al (2019) Comparison of the outcomes of navigation-assisted revision of unicompartmental knee arthroplasty to total knee arthroplasty versus navigation-assisted primary TKA. Int Orthop 43(2):315–322. https://doi.org/10.1007/s00264-018-4028-2
14. Zung WW (1971) A rating instrument for anxiety disorders. Psychosomatics 12(6):371–379
15. Ware JE Jr, Sherbourne CD (1992) The MOS 36-item short-form health survey (SF-36). I Conceptual framework and item selection. Med Care 30(6):473–483
16. Ahn Y (2019) Endoscopic spine discectomy: indications and outcomes. Int Orthop 43(4):909–916. https://doi.org/10.1007/s00264-018-04283-w
17. Schluessmann E, Aghayev E, Staub L et al (2010) SWISSspine: the case of a governmentally required HTA-registry for total disc arthroplasty: results of cervical disc prostheses. Spine 35(24): E1397–E1405. https://doi.org/10.1097/BRS.0b013e3181e0e871
18. Demyttenaere K, Bruffaerts R, Lee S et al (2007) Mental disorders among persons with chronic back or neck pain: results from the world mental health surveys. Pain 129(3):332–342
19. Blozik E, Laptinskaya D, Herrmann-Lingen C et al (2009) Depression and anxiety as major determinants of neck pain: a cross-sectional study in general practice. BMC Musculoskelet Disord 10:13. https://doi.org/10.1186/1471-2474-10-13
20. Velasco RV, Bakhshaie J, Walker RL et al (2016) Synergistic effects of pain intensity and anxiety sensitivity in relation to anxiety and depressive symptoms and disorders among economically disadvantaged latinos in a community-based primary care setting. J Anxiety Disord 43:23–31. https://doi.org/10.1016/j.janxdis.2016.07.007
21. Currie SR, Wang J (2004) Chronic back pain and major depression in the general Canadian population. Pain 107(1–2):54–60
22. Dunn LK, Durieux ME, Fernandez LG et al (2018) Influence of catastrophizing, anxiety, and depression on in-hospital opioid consumption, pain, and quality of recovery after adult spine surgery. J Neurosurg Spine 28(1):119–126. https://doi.org/10.3171/2017.5.SPINE1734
23. Marshman LA, Kasis A, Krishna M, Bhatia CK (2010) Does symptom duration correlate negatively with outcome after posterior lumbar interbody fusion for chronic low back pain? Spine 35(6):657–665. https://doi.org/10.1097/BRS.0b013e3181bb8ebd
24. Brisby H (2006) Pathology and possible mechanisms of nervous system response to disc degeneration. J Bone Joint Surg Am 88(Suppl 2):68–71
25. Heikkinen J, Honkanen R, Williams L et al (2019) Depressive disorders, anxiety disorders and subjective mental health in common musculoskeletal diseases: a review. Maturitas 127:18–25. https://doi.org/10.1016/j.maturitas.2019.05.011
26. Jess MA, Ryan C, Hamilton S et al (2018) Does duration of pain at baseline influence clinical outcomes of low Back pain patients managed on an evidence-based pathway? Spine 43(17):E998–E1004. https://doi.org/10.1097/BRS.0000000000002612
27. Simon J, McAuliffe M, Shamim F et al (2014) Discogenic low back pain. Phys Med Rehabil Clin N Am 25(2):305–317. https://doi.org/10.1016/j.pmr.2014.01.006