Percutaneous Endoscopic Transforaminal Discectomy vs Conventional Open Lumbar Discectomy for Lumbar Disc Herniation: a Systematic Review

Abstract

Introduction: Despite the fact that there are various surgical procedures for lumbar disc herniation, open lumbar microdiscectomy is the most effective. Percutaneous endoscopic lumbar discectomy has recently become a popular procedure for treating herniated lumbar discs.

Objectives: The aim of this study is to determine whether percutaneous endoscopic lumbar discectomy and conventional open lumbar discectomy show better results as a surgical treatment of lumbar disc herniation. To evaluate the surgical outcomes and advantages of each technique as well as to describe the technical strategy and evaluate the outcomes of the PETD technique specific to LDH

Methods: In this review's analysis, studies examining endoscopic percutaneous endoscopic transforaminal discectomy and conventional open discectomy—both surgical procedures for treating herniated lumbar discs—were looked at. In the Google Scholar and PubMed databases, papers published between 1973, the year percutaneous endoscopic lumbar discectomy was first introduced, and 2022 were searched.

Results: The 8 publications that had 5,314 patients were chosen. Percutaneous endoscopic lumbar discectomy has a noticeably better outcome than open lumbar microdiscectomy, according to the comparative study. All procedures have good results, as seen by the comparison between PETD operations and traditional surgical discectomy. A better visual analog pain scale (VAS), a better confidence interval, reduced blood loss, a shorter operating time, a shorter length of stay, fewer complication rates, lower recurrence rates, and a low reoperation rate are some benefits of the PETD method.

Conclusion: Although percutaneous endoscopic lumbar discectomy exhibits superior outcomes to traditional surgical discectomy in a number of areas. The traditional open discectomy still yields positive clinical outcomes. In order to compare these two surgical approaches, it is anticipated that a systematic review trial with a sizable research sample and more literature would be required in the future.

Key words: Discectomy, Lumbar, Herniation

1. Introduction

An inner nucleus pulposus (NP) and an outer annulus fibrosus make up the intervertebral disc (AF). Numerous proteoglycans (PG) are found in the central NP, which secretes collagen and helps retain water, generating hydrostatic pressure that prevents the spine from being compressed axially (Kadow T, 2015). Type II collagen makes up the majority of the NP, making up 20% of its total dry weight. Contrarily, the AF works to keep the NP in the disc's center while using a minimal amount of PG; 70% of its dry weight is made up primarily of concentric type I collagen fibers (Kalb S, 2012). Thecal sac space in LDH may become more constrained as a result of disc protrusion through an intact AF, extrusion, or both.

A low incidence of 1–10.4% of lumbar disc herniation (LDH), which is defined as the rupture of the annulus fibrosa and protrusion of the nucleus pulposus at L3–4 or above, is accompanied by a high risk of misdiagnosis (Yuce I, 2019). The upper and lower LDH differ anatomically in a variety of ways, including a small spinal canal, a close proximity to the lumbosacral expansion of the spinal cord, a short nerve root, and a tight space between the exiting nerve roots and the dura (Lee D.S, 2013). Despite the greater difficulties, hazards, and unsatisfactory outcomes of surgery, surgical decompression for LDH is nevertheless very significant (Ziquan Li, 2020).

Percutaneous endoscopic lumbar discectomy has the same effectiveness as traditional surgery, according to an increasing number of clinical studies conducted in recent years, but it also offers benefits including minimum bleeding, less harm to soft tissues, and quicker postoperative recovery (Kim M, 2018). Percutaneous endoscopic transforaminal discectomy (PETD), which does not require laminectomy and Dural traction, is said to be a viable alternative to LDH thanks to the development and improvement of surgical procedures (Shin M.H, 2019). There aren't many articles on PETD for LDH, and there haven't been any trials comparing it to open discectomy in the management of LDH. As a result, we conducted a systematic review study comparing PETD with traditional open discectomy to assess the surgical results and benefits of each technique and to outline a particular technique.

2. Objectives

The aim of this study is to determine whether percutaneous endoscopic lumbar discectomy and conventional open lumbar discectomy show better results as a surgical treatment of lumbar disc herniation. To evaluate the surgical outcomes and advantages of each technique as well as to describe the technical strategy and evaluate the outcomes of the PETD technique specific to LDH.

3. Methods

3.1 A systematic search was performed on PubMed and Google Scholar for a randomized trial from inception to July 10, 2022. Without regard to language, a randomized controlled trial examining several surgical techniques in lumbar disc herniation was discovered. Keywords included lumbar herniation, conventional open discectomy, percutaneous endoscopic transforaminal discectomy, and endoscopic discectomy. The trial was entered according to the following criteria: (1) a comparison was made between PETD and conventional open discectomy; (2) the trial intervention was PETD and conventional open discectomy (3); the patients were adults who had lumbar herniation and failed conservative treatment; (4) contains at least 1 result of interest. trials were excluded if: the intervention differed from the previous description.

3.2 Screening

After initial identification of titles and abstracts, 7550 articles were obtained from Google scholar, and from PubMed acquired 841, so the total result articles were 8931. The research was screened by title and abstract, and then 306 articles were obtained. The researcher reviewed the full-text category. 296 journals were excluded because they did not meet the requirements. 10 remaining journals were reviewed in full, and 2 were excluded because they were not eligible for inclusion criteria. In the final stage, 8 remaining studies were reviewed and screened for inclusion based on relevance to the subject and outcomes.

3.3 Inclusion Criteria and Exclusion Criteria

The following criteria were used to choose the papers that were searched: (1) those that were either randomized or nonrandomized controlled trials, (2) those that involved LDH patients who underwent PETD or conventional open lumbar discectomy and had at least significant degenerative symptoms and patient trauma, and (3) those that involved patients who underwent PETD or conventional open lumbar discectomy for lumbar disc herniation. The studies on patients who (1) underwent combined surgery and lesions in more than one location, (2) had insufficient data, and (3) underwent animal testing were disregarded.

3.4 Data extraction and Synthesis of Data

Independent data extraction was done by the researchers. We carefully isolated and studied interesting trial characteristics and outcomes. Operative time, hospital stay, blood loss, and complication rates between PETD and traditional open discectomy were the main outcomes. Secondary results included clinical outcomes compared between PETD and traditional open discectomy using MACNAB criteria, reoperation rate, recurrence rate, visual analogue scale (VAS), ODI, and Japanese orthopedic association back pain evaluation questionnaire (JOA). The MACNAB criteria were used to assess the clinical outcome, fluoroscopy time, operation time, postoperative bed rest time, and other factors. A subgroup analysis based on trial intervention was carried out to better accurately compare the effects of various surgical methods.

3.5 Assessment of risk of bias

The selection process risk-of-bias criteria was used for evaluating the risk of bias in each included trial. The classifications of bias were based on 7 items: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias. Each item was rated as low risk, unclear risk, or high risk.

Table 1. Article Search Process

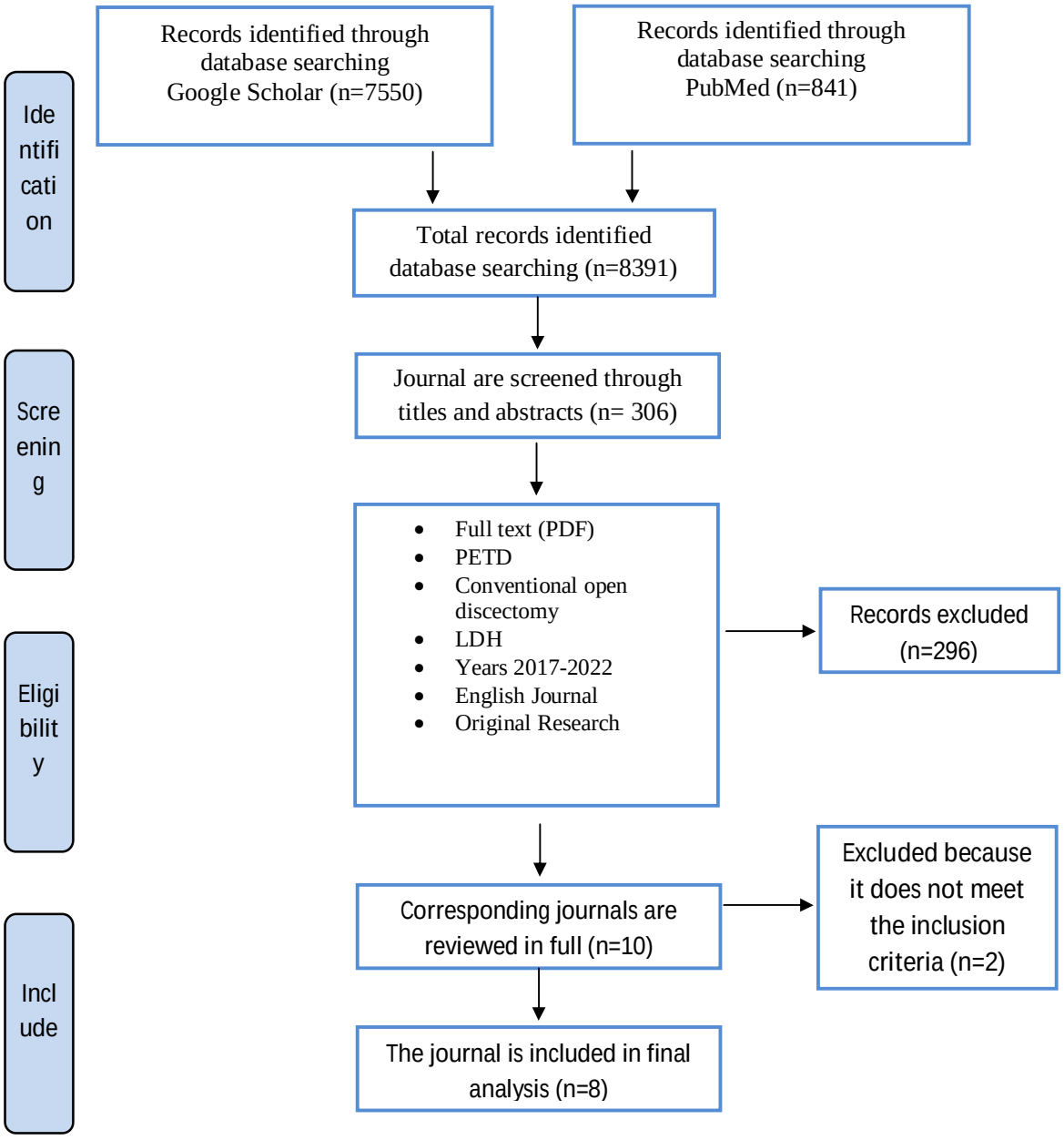

Table 2. studies Characteristic

No	Author	Title	Objectives	Methods study / design study	Instrument	Sample	Result
1.	(Wei-shang Li et all., 2022)	Comparison of endoscopy discectomy versus non-endoscopic discectomy for symptomatic lumbar disc herniation: a systematic review and meta-analysis	to systematically compare the effectiveness and safety of endoscopic discectomy (ED) with non-endoscopic discectomy (NED) for treatment of symptomatic lumbar disc herniation (LDH)	Systematic review and meta-analysis	Randomized control trial	(n=2258)	Percutaneous endoscopic lumbar discectomy (PELD) required less time in the hospital than fenestration discectomy (FD). The intraoperative blood loss volumes between PELD with FD and MED with OD were observed to differ significantly.
2.	(Colin Komahen et all., 2022)	Clinical outcomes of transforaminal percutaneous endoscopic lumbar discectomy in Malaysia	present clinical outcomes of TPED among the Malaysian population.	Retrospective study	Retrospective analysis	(n=30)	Sample of 30 individuals with a mean age of 40.7 years were included for the PETD procedure. With a mean symptom duration of roughly 6.5 months, radiculopathy was the most common diagnosis. Six months after surgery, there was a considerable decline in the mean Analog Scale Score (VAS). According to the Macnab Criteria, three-quarters of the patients had excellent results, and the mean Oswestry Disability Index increased significantly. There was no correlation between the Macnab outcome and patient characteristics, despite the fact that only 3 problems (nerve injury, recurrence, and skin

							irritation) occurred.
3.	(Uleschenko D.V. et all., 2022)	Evaluation of Outcomes of Surgical Treatment of Herniated Discs in the Lumbar Spine by Different Methods on the VAS and Oswestry Scales	to evaluate the outcomes of surgical treatment of disc herniation in the lumbar spine using different methods (microdiscectomy vs. endoscopy) according to the VAS and Oswestry scales.	Comparison study	Retrospective analysis	(n=54)	Endoscopic surgical methods have an advantage over microdiscectomy because they shorten hospital stays while producing the same clinical results.
4.	(Cheng Ma et all., 2021)	Comparison of percutaneous endoscopic interlaminar discectomy and open fenestration discectomy for single-segment huge lumbar disc herniation: a two years follow-up retrospective study	The purpose of this retrospective study was to compare the surgical outcomes of percutaneous endoscopic interlaminar discectomy (PEID) and OFD for single-segment huge lumbar disc herniation (HLDH).	Retrospective study	Retrospective analysis	(n=91)	PEID has the following advantages over conventional surgery: less trauma, less bleeding, quick recovery, and shorter hospital stay. Consequently, PEID might be a promising replacement for conventional surgery.
5.	(Xingping Xu et all., 2021)	Clinical efficacy and safety of percutaneous spinal endoscopy versus traditional open surgery for lumbar disc herniation: systematic review and meta-analysis	Systematic analysis of the incidence of percutaneous spinal endoscopic technique and traditional open surgery for lumbar disc herniation.	Systematic review and meta-analysis	Randomized control trial		Percutaneous spinal endoscopic technology has clear advantages over traditional open surgery for treating lumbar disc herniation in terms of reducing nerve root injury, dural injury, and wound complications, but it is only capable of preventing the technical aspects of the surgical site, which are worse than those of open surgery.
6.	(Ziquan Li et all., 2020)	Percutaneous endoscopic transforaminal discectomy versus conventional open lumbar discectomy for upper lumbar disc herniation: a comparative cohort study	To compare studies have evaluated PETD for upper LDH, and no study has compared the advantages of endoscopic procedures versus conventional surgery	Comparative cohort study	Two group random control trial	(n=42)	Conclusion: Compared to traditional surgical techniques, PETD surgically produces good outcomes in the treatment of upper LDH and results in a lower incidence of iatrogenic harm, minimum activity

							recovery, and quicker ambulation recovery.
7.	(Manyoung Kim et all., 2018)	A Comparison of Percutaneous Endoscopic Lumbar Discectomy and Open Lumbar Microdiscectomy for Lumbar Disc Herniation in the Korean: A Meta-Analysis	to determine through a meta-analysis whether PELD or OLD has better results as a surgical treatment for lumbar disc herniation in the Korean population.	Meta-analysis	Secondary data collection	(n=1254)	Percutaneous endoscopic lumbar discectomy outperformed open lumbar microdiscectomy in several areas, although both procedures still produced positive clinical outcomes.
8.	(Rongqing Qin et all., 2018)	Percutaneous Endoscopic Lumbar Discectomy Versus Posterior Open Lumbar Microdiscectomy for the Treatment of Symptomatic Lumbar Disc Herniation: A Systemic Review and Meta-Analysis	The purpose of this systematic review and meta-analysis was to compare the clinical efficacy between percutaneous endoscopic lumbar discectomy (PELD) versus posterior open lumbar microdiscectomy (OLMD) for the treatment of symptomatic lumbar disc herniation.	Systematic review and meta-analysis	Secondary data collection	(n=1585)	In comparison to the OLMD group, the PELD group showed a higher incidence of residual disk or incomplete decompression. Additionally, there was no discernible difference in the length of the procedure between the 2 groups; however, the PELD group was linked to a quicker hospital stay and return to work period.

3.6 Methodological characteristic

Base on the eight studies reviewed, three used the systematic review and meta-analysis method (Wei-shang Li et all., 2022), (Xingping Xu et all., 2021), (Rongqing Qin et all., 2018). Two used retrospective study (Colin Komahen et all., 2022) and (Cheng Ma et all., 2021). Two comparative study (Uleschenko D.V. et all., 2022) and (Ziquan Li et all., 2020). One used meta-analysis (Manyoung Kim et all., 2018).

3.7 Intervention methods

Out of the eight studies, three studies used systematic review and meta-analysis (Wei-shang Li et all., 2022), (Xingping Xu et all., 2021), (Rongqing Qin et all., 2018). Two studies used a retrospective study (Colin Komahen et all., 2022) and (Cheng Ma et all., 2021). Two comparative study (Uleschenko D.V. et all., 2022) and (Ziquan Li et all., 2020). One study used a meta-analysis (Manyoung Kim et all., 2018).

4. Result

Of the 8.391 records that were initially found, eight studies had their full texts reviewed. After searching through 306 papers, 296 were eliminated since they didn't fit the requirements. The process of choosing the papers is shown in Figure 1, and the final 8 papers that met the inclusion criteria were used in this study's analysis. Of the 8.391 records that were initially found, eight studies had their full texts reviewed. After searching through 306 papers, 296 were eliminated since they didn't fit the requirements. The process of choosing the papers is shown in Figure 1, and the final 8 papers that met the inclusion criteria were used in this study's analysis. 7 out of 8 studies showed that a comparison between PETD procedures and conventional open discectomy showed that all procedures showed good results. However, the PETD procedure has advantages including better visual analog pain scale (VAS), better confidence interval, lower oswestry disability, shorter operating time, shorter hospitalization time, lower complication rate, lower recurrence rate and reoperation rate is also low.

5. Discussion

A total of eight papers that are pertinent to the topics and results were found by the systematic review. Due to extensive bone tissue removal that could result in segmental spinal instability and iatrogenic spondylolysis, the standard posterior technique has the drawback of requiring patients to undergo internal fixation and lumbar fusion. Minimally invasive percutaneous endoscopic transforaminal surgery, which was previously used to treat lower LDH, has emerged as an alternative method for treating LDH in order to avoid the iatrogenic instability and spinal fusion caused by conventional posterior lumbar discectomy for LDH. When compared to the conventional approach, PETD for LDH reportedly results in decreased iatrogenic injury, accelerated rehabilitation, and decreased hospitalization.

The following considerations may affect the unique benefits of PETD over traditional posterior lumbar discectomy. As a result of the smaller skin incision, reduced iatrogenic tissue

trauma, less paravertebral muscle injury, and preservation of posterior ligamentous and bony structures, PETD firstly leads to a shorter operating time, minimal blood loss and wound drainage, fewer wound complications, and less postoperative instability. Second, it is possible to perform PETD while under local anesthesia and conscious sedation, which results in fewer issues from the anesthetic and a speedier recovery time with a shorter hospital stay. It has been demonstrated that the early, quick recovery helps to lower deep vein thrombosis. Additionally, by employing a transforaminal endoscopic technique at the lumbar level, the extruded disc can be removed without Dural retraction, and the segmental motion can be.

5.1 Preoperation

a. Vas score

Seven of the eight publications found that, using the VAS score, the mean amount of leg discomfort in patients who had undergone PETD and conventional open lumbar discectomy at follow-up days 1, 3, and 12 months after surgery decreased. The traditional lumbar discectomy in the second group, which was evaluated using the vas score, revealed a postoperative score of 3–4, while the PETD revealed a significant vas score of 1-2.

b. JOA score

After PETD and traditional open discectomy were performed, the findings of the evaluation of the JOA score improved significantly. Of the 8 publications, 8 showed the JOA score before surgery in both groups of patients had a moderate and severe mean severity. There is no difference in the significant values of the two measures.

c. Oswestry disability index

In 8 of the 8 publications, the Oswestry Disability Index was provided prior to surgery in both patient groups with mean severity scores of moderate and severe. Following PETD and traditional open discectomy, the findings of the evaluation of the Oswestry Disability Index showed a reasonable improvement. There is no difference in the significant values of the two measures.

d. Macnab Classification at the Final Follow-Up

The Macnab score (success rate) results were provided in 8 of the 8 studies, and 1,039 participants were analyzed, 357 in the PETD group and 682 in the Open Lumbar Discectomy group. 298 out of the 357 participants in the PETD group responded with "success" in the Macnab criteria, which was regarded as excellent or good. 564 of the 682 participants in the conventional open lumbar discectomy group correctly responded. Between the PETD and Conventional Open Lumbar Discectomy group groups, the average Macnab score (success rate) did not differ significantly.

5.2 Intraoperation

Under general anesthesia, the conventional open lumbar discectomy group underwent the procedure while prone on a radiolucent operating table. After dividing the paravertebral muscles, a midline skin incision is done. The borders of the prior laminotomy are carefully marked by

removing scar tissue while taking care to avoid rupturing the dura mater. The use of implants, microdiscectomies, laminotomies or laminectomy, and discectomies with or without fusion are only a few surgical techniques. After sufficient nerve root decompression, each wound is stitched up in layers.

In the PETD group, PETD is carried out under local anesthetic while the patient is in the lateral decubitus posture. Under AP and lateral C-arm fluoroscopy guidance, the surgical segment and puncture entry location were confirmed. The Dural sac and nerve roots are believed to be damaged by the needle's sharp angle of passage (35–45°) and the patient's ongoing input. On the AP fluoroscopy view, the middle needle is seen near the posterior edge of the intervertebral disc and vertebral body as it moves toward the pedicle line. A working cannula (endoscope system) is then inserted after the needle is swapped out for a guidewire and an obturator that enlarges through the guidewire. Endoscopic forceps and coagulation were used to resect the herniated disc's burst portion. To ensure that decompression is accomplished, special attention is paid to the region between the disc and ligamentum flavum as well as the ventral and lateral sides of the traversing nerve roots. The surgeon confirmed the endoscopic results after the procedure: Free nerve tissue mobilization, independent pulsation of the Dural sac and nerve roots (consistent with heart rate), restoration of the anatomical location of the nervous tissue, and improved blood flow to the nerve tissue are all required for decompression. Additionally, the surgeon attested to the medication's waning effects and the unsuccessful effects of intraoperative straight leg therapy.

a. Operation Time.

Four of the eight papers—two from the PETD group and one from the conventional open lumbar discectomy—presented the outcomes of the operation time. The typical operation time for the PETD group was 50–60 minutes, whereas it took 80–90 minutes for a conventional open lumbar discectomy. The typical operation time for the PETD group was considerably less than that for the conventional open lumbar discectomy.

b. Blood Loss

One of the eight papers addressed the effects of blood loss, and subjects from both the PETD group of 201 and the conventional open lumbar discectomy group of 211 were examined. The typical blood loss in the PETD group was 20 to 30 cc, compared to 80 to 120 cc in the case of conventional open lumbar discectomy. The intraoperative blood loss volume was significantly different between PETD and Conventional Open Lumbar Discectomy.

5.3 Post operation

a. Postoperative Paresthesia

The heterogeneity test was conducted on 3 of the 8 presented publications and it was discovered that the heterogeneity of the chosen research was minimal, allowing for the performance of a systematic review. According to the findings of the systematic review, there was no statistically significant difference between PETD and Conventional Open Lumbar Discectomy in terms of postoperative paresthesia.

b. Complication infection Rate

Four of the eight papers—out of 1,115—presented the findings of the complication rate. 392 patients underwent a PETD while 723 underwent a conventional open lumbar discectomy. Complications occurred in 15 patients in the PETD group and 27 in the conventional open lumbar discectomy group. Between the PETD and Conventional Open Lumbar Discectomy, the complication rate did not differ significantly.

c. Direct Nerve Root Damage

Six of the eight papers were presented, and the heterogeneity test revealed that there was little heterogeneity among the chosen studies. The results of the systematic review also revealed that there was no statistically significant difference between PETD and conventional open lumbar discectomy in terms of direct nerve root damage.

d. Reoperation rate

In four of the eight studies, the reoperation rate results were published. A total of 1,065 participants were analyzed, 372 in the PETD group and 693 in the conventional open lumbar discectomy group. Reoperations were performed on 43 patients who underwent conventional open lumbar discectomy and 31 patients who underwent PETD. Between the PETD and Conventional Open Lumbar Discectomy, the reoperation rate did not differ significantly.

e. Disc Recurrence

Six of the eight articles gave results demonstrating a systematic statistical difference between PETD and conventional open lumbar discectomy in terms of disc recurrence, with conventional open lumbar discectomy having higher recurrences than PETD.

f. Hospital stays.

Four of the eight papers—one each from the PETD group and the conventional open lumbar discectomy group—presented the outcomes of hospitalization. The typical hospital stay for the PETD group was two to three days, whereas it took seven to eight days for the conventional open lumbar discectomy group. The average length of stay in the hospital for the PETD group was much lower than for the conventional open lumbar discectomy.

Many complications of PETD surgery have not discussed on this study, because there are just a few literatures that discuss it. Further research should discuss the complications of PETD surgery and review other journals with a larger amount of literature.

6. Conclusion

From all this research it can be concluded that PETD surgery and conventional open discectomy have the same good clinical results. but PETD has advantages which are shortening the operation time, lowering oswestry disability, reducing blood loss, shortening the length of stay, better confidence interval, improving visual analog pain scale (VAS), lowering complication rate, as well as lowering recurrence and reoperation rate. Although not the gold

standard, the PETD procedure can also be an alternative for the management of lumbar disc herniation

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