



**CLINICAL OUTCOME OF PERCUTANEOUS ENDOSCOPIC LUMBAR
DISCECTOMY AND OPEN LUMBAR MICRODISCECTOMY FOR LUMBAR
DISC HERNIATION: A LITERATURE REVIEW**

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ABSTRACT

Percutaneous endoscopic lumbar discectomy (PELD) is newly developed technique to the management of lumbar disc herniation (LDH), was introduced in 1986. This method used a tubular retractor and endoscope for visualization. Open lumbar microdiscectomy (OLM) used the microscope for visualization was introduced in late 1970s. This method considered as the gold standard technique for the treatment of LDH. The aim of this study to compare the advantage and disadvantage of the operative method and clinical outcomes reported in the published literature for both PELD and OLM for the management of LDH.

Keywords: Percutaneous endoscopic lumbar discectomy, Open lumbar microdiscectomy, Lumbar disc herniation.

INTRODUCTION

Lumbar disc herniation (LDH) is a common cause of back pain and leg pain. About 70% to 85% of people affect at least one episode of back pain in their lives in the world (1). Back pain and leg pain are mainly related with LDH. Epidemiological study noted that with the advance aging population, the quantity of patients with LDH and degeneration of disc has also raised (2, 3). When failed the conservative management [such as nonsteroidal anti-inflammatory drug (NSAID), traction, steroid injection, nerve root block and physiotherapy] then standard open discectomy done to manage the pain elicited from LDH. Though operative technique develop more in the last few year, OLM remains considered as a gold standard method for LDH. However, it take longer hospital stay and recovery time (4). LDH managed by open discectomy traditionally however; there was disadvantage like muscular injury, the removal of yellow ligament and retraction of nerve root. This could cause instability and epidural scarring. However, it takes long hospital stay and time for recovery (4, 5). Therefore some new techniques with the help of modern devices such as microscopy, optical fiber visualization has been introduced and gradually increase popularity to decrease the disadvantage of open discectomy and decrease surgical invasive. With the advance technology the percutaneous endoscopic discectomy has gained increasing demand for the management of LDH in the spine hospitals (6). Kambin and Sampson in 1986, describe the percutaneous posterolateral approach since PELD has become famous last few years for excision of herniated disc tissue (7). The idea of OLM was described by Williams, that became gold standard of operative management for LDH (1). However, OLM operation could lead to muscular injury, partial laminectomy, removal of yellow ligament and retraction of nerve root. This could cause instability and epidural scarring that result to clinical symptoms in greater than 10 percent of patients (1, 5).

METHOD

Relevant literatures were found by searching Pubmed, Google scholar, Cochrane library databases was performed for articles that are randomised trials, prospective, controlled study, retrospective and reviews, with the subsequent key words for literature searches are “Lumbar disc herniation”, percutaneous endoscopic lumbar discectomy” “open lumbar microdiscectomy”, “treatment outcome”. To find the appropriate study, we scanned reference list by manually from identified trials and review article.

RESULTS

Surgical indication for PELD and OLM:

Recently, several surgeons have developed numerous novel method and instruments that expanded the indications of PELD and OLM for treatment of LDH. The operating surgeon chooses operating method according to indication of PELD and OLM for management of LDH.

Surgical indication of PELD:

PELD generally fitted for unilateral, one level extruded discs and free fragments. 1) There's continuous radicular leg pain and numbness caused by herniation of disc compromising nerve root

(contained or non-contained) diagnosed by magnetic resonance imaging (MRI), computed tomography (CT) scan, myelography and other technique. 2) positive compression or tension signs or sensory and motor or reflexes disordered are present, 3) the patient failure to responded the conservative management, 4) this method is perfect for extruded herniated discs and free herniated fragments and 5) obese patient or poor health condition in order to that open surgery could be higher risk treatment. (This is an extra consideration) (8).

Surgical indications of OLM:

It includes unilateral radicular leg pain very severe than low back pain, positive straight leg raise test, cross leg test, braggard's test, femoral stretch test another signs of root disorder and patient failure to improve with conservative management over six weeks with persistent symptoms. An abnormal electromyogram (EMG) test correspond to the level of the abnormal disc gives extra support for using this procedure. Now a days the microsurgical operating method is widely being performed for treatment of recurrent herniation of discs, far lateral herniated discs and foraminal stenosis (9).

Surgical Technique:

In each group, PELD and OLM group, all surgery followed a standard protocol recommended in the previous published article (10).

Percutaneous endoscopic lumbar discectomy (PELD):

The procedure of PELD was performed under local anaesthesia with the patient placed in prone position on a radiolucent operating table (7). Patient was kept awake state throughout whole surgery to watch the heart rate, blood pressure, saturation and any changes in the sign and symptoms throughout surgery (11). After the skin entry point infiltrated with local anaesthesia (LA) then 18 gauge spinal needle was inserted under fluoroscope guidance control (10). The target point of the needle tip was positioned the medial pedicular line in the anteroposterior view and posterior vertebral borderline on lateral view (5, 10). Once insertions of spinal needle, discogram was done using methylene blue. Discogram confirm the pathological level and methyl blue stained nucleus pulposus blue and help to remove pathologic disc. Following additional steps the guide wire was inserted via spinal needle then spinal needle was took out (7, 12). The skin was incised about 8mm in length at entry point and dilator was inserted by a twisting maneuver over the guide wire in the disc. There are 2 methods for PELD that is intradisc Yeung endoscopic spine system (YESS) and intracanal transforaminal endoscopic surgical system (TESSYS). The working cannula was inserted into the disc space along the dilator, followed by dilator and guide wire was took out (5). After an endoscopic operative tools was inserted via working cannula, blue stained disc was excised using endoscopic forceps and the herniated disc tissue, fibrotic scar tissue was removed (13). After finishing the complete the operative procedure, all working tolls are removed and skin closed with single suture (5).

Open lumbar microdiscectomy (OLM):

The concept of OLM was introduced by William that is standard operative management for LDH (1).

OLM was done under general anaesthesia with the patient placed in prone position on radiolucent operating table (10). The skin was incised usually about 2-4 cm posterior middle line on spinus process and paraspinus muscle was dissected (14). Then the further step under microscopic view limited laminectomy and medial facetectomy not more than one third of the whole facet joint was perform using high speed drill and yellow ligament was excised on the area of exposure (7). Then the instrument was inserting to the thecal sac and nerve root to be exposed. The lightly nerve root was retracted and epidural dissection done. The fragments of herniated disc were excised by pituitary forceps and kerrison rongeurs, reverse angle curettes and ring curette (14, 15). When nerve root fully decompression was done then the instruments was took out and skin sutured was done with 1:0, 2:0, and 4:0 absorbable suture (5, 15).

Comparison of PELD and OLM:

In these two methods, there is various difference. In the PELD method, paraspinal muscle is handling and endoscope is utilized for visualization. In PELD method paraspinus muscle weren't dissected from spinus process and working tools (like spinal needle, guide wire, dilator and working tube) are inserted between the tips of the spinus process. In the OLM method the paraspinal muscle was being detached from spinus and lamina. The results in lesser muscular injury thus cause less post operative incision pain. Another difference includes is utilize of operating endoscope and operating microscope for better visualization.

Comparison of clinical outcome: PELD versus OLM:

In nine studies, that includes five retrospective and four prospective studies. I reviewed, the surgical satisfaction is more in the PELD than OLM methods for management of LDH, reason is operation time, hospital stay, intraoperative blood loss and come back to work was significantly shorter in PELD method than the OLM method. However there's not a significant differences in leg pain in these two groups however decrease of back pain in PELD is more than the OLM methods after operation which shown in the table 1(A & B). Ruetten S et al in 2008, (16) done a study they showed 178 cases underwent full endoscopic lumbar discectomy or microdiscectomy with two years period of follow up. According to the visual analogue scale (VAS) and Oswestry disability index (ODI) scores about 82% cases improve significantly in leg pain, back pain and return normal working activity in these two groups. There are not significant differences in outcome in both groups. However the full endoscopic discectomy (FED) brings important advantage over the following section: back pain, rehabilitation, complication and traumatization. Therefore FED is better alternative to open microdiscectomy. This studies results is similar to another two published literature by Mayer in 1993 (17) and Ruetten. S in 2009 (18). Kim M-J et al in 2007 (19), in their retrospective study 902 cases with LDH, of these 295 and 607 cases treated with PELD and microdiscectomy respectively with period of follow up was 18-36 months. In this study showed results is satisfactory; the outcome is 84.4% in PELD method that is comparable to the results 85% of the microdiscectomy. Therefore on the basis of this outcome, PELD is an alternative option to OLM for treatment of LDH. Lee J-S et al in 2017, in their study, 83 cases underwent reoperation of these in PELD 35 and OLM 48 cases respectively for recurrent LDH with follow up period was 12-54 months. At the follow up period according to VAS and ODI symptoms was improve significantly in

these two groups, however there are no differences in these two groups. Although these two groups have favorable results, PELD can be an alternative to OLM for operative treatment of recurrent LDH (20). This study is similar to retrospective study done by Lee D.Y in 2009 (10). Choi K.C et al in their study include 43 cases of these 20 and 23 case treated with PELD and OLM respectively for the large lumbar disc herniation (LLDH) with follow up period was 24-37 months. They noted, in each group after operation great improvement is leg and back pain though there was no difference in improvement of leg pain however improve in back pain was considerably more in PELD than OLM. The advantage of PELD includes improvement of back pain, quick recovery, disc height preservation and less muscular injury. Therefore PELD is suitable operative treatment for LLDH (7). In 2016, Gibson J.N et al (21), prospective randomised control trial reports 140 patients of LDH with radiculopathy which is taken 70 patients in transforaminal endoscopic discectomy (TED) and 70 patients in OLM and underwent TED and OLM with 2 years of follow up. An author concludes that the outcome significantly improved in both group. Beside short hospital stay and less leg pain during 2 years following TED, there is little disappointment by repeated MRI and revision of surgery. As TED can perform under local anaesthesia and short hospital stay which makes the TED ideal for the management of LDH. In 2016, Ahn S.S et al (5), done retrospective matched cohort study in total 66 patient of age 20-25 years old were taken of these 32 and 34 patients in PELD and OLM respectively with follow up period was 1 year. As per this study VAS and ODI shows improvement in back pain, leg pain and radiological outcome was same in both group. The author also reports the advantage of PELD include procedure perform under local anaesthesia, surgical time, length of hospital stay and return to work time is shorter than OLM. Hence the PELD seems to be good choice for LDH in young patients.

Author/ year	Study Design	Sample Size	OUTCOME										F/U
			PELD										
			Num ber	Op-time (min)	Blood Loss	Hosp Stay (Day)	VAS				ODI		
							Pre-op		Post-op		Pre-op	Post-op	
Leg	Back	Leg	Back	Pre-op	Post-op								
Mayer/ 1993	PRS	40	20	40.7±11.3	-	-	4.55±0.99	19	8.23±1.3	10 (47%) imp	-	-	2 yrs
Kim M.J/2007	Retrospective	902	295	53.0±13.0	Neg	-	-	-	-	-	-	-	18- 36 mont hs
Ruetten.S /2008	PRS	178	91	13-46	Neg	-	-	-	85% imp	-	-	-	2 yrs
Lee D.Y/2009	Retrospective	54	25	45.8±11.1	-	0.9±0.5	8.4±1.7	7.0±2.8	2.9±2.5	2.9±2.4	61.6±22.1	20.7±15.9	25- 41 mont hs
Ruetten.S /2009	PRS	161	81	28-57	Neg	-	-	-	76.5% imp	-	-	-	2 yrs
Choi K.C/2016	Retrospective	43	20	67.0±12.0	Neg	1.5±1.1	7.5±1.1	6.9±1.4	1.7±1.2	2.0±0.6	61.6±13.9	12.5±7.5	2 yrs
Gibson J.N.A/201 6	PRS	140	70	61±16	-	0-2	6.2±2.8	5.7±2.7	1.9±2.6	2.5±2.5	44±83	18±17	2 yrs
AhnS.S/ 2016	Retrospective	66	32	48.66±6.45	Neg	7.50±2.63	7.53±0.92	4.41±0.98	2.06±0.8 4	2.50±0.62	24.9±2.28	9.63±2.31	1 yrs
Lee J- S/2017	Retrospective	83	35	-	-	-	8.2±0.63	4.94±0.91	2.23±0.6 5	2.23±0.65	44.17±2.7 6	15.31±2.97	12- 54 mont hs

Table 1 A: Comparison of clinical outcomes of PELD and OLM for LDH.

PELD: percutaneous endoscopic lumbar discectomy, OLM: open lumbar microdiscectomy, f/u: follow up, op-

time: operative time, min: minute, hosp stay: hospital stay, VAS: visual analogue scale, ODI: Oswestry Disability Index, pre-op: preoperative, post-op: postoperative, imp: Improvement (the difference between preoperative and postoperative score), neg: negligible, yrs: year, PRS: Prospective Randomized Study.

Author/ year	Study Design	Sample Size	OUTCOME										F/U
			OLM										
			Num ber	Op-time (min)	Blood Loss(ml)	Hosp Stay (Day)	VAS				ODI		
							Pre-op		Post-op		Pre-op	Post-op	
Leg	Back	Leg					Back						
Mayer/ 1993	PRS	40	20	58.2±15.2	-	-	4.2±0.98	20	7.67±1.9	15 (25)% imp	-	-	2 yrs
Kim M.J/ 2007	Retrospective	902	607	64.6±28.7	Neg	-	-	-	-	-	-	-	18- 36 mont hs
Ruetten.S /2008	PRS	178	87	34-72	5-235	-	-	-	79% imp	-	-	-	2 yrs
Lee D.Y/ 2009	Retrospective	54	29	73.8±25.7	-	3.8±1.4	8.6±1.7	5.4±3.7	3.5±3.1	3.1±2.5	63.1±22.3	18.2±15.4	25- 41 mont hs
Ruetten.S /2009	PRS	161	80	32-79	15- 275	-	-	-	73% imp	-	-	-	2 yrs
Choi K.C/ 2016	Retrospective	43	23	136.7±53	200.9 ±86.9	7.2±3.5	7.3±1.1	6.1±1.0	2.3±0.8	3.7±1.0	66.1±11.1	20.2±7.2	2 yrs
Gibson J.N.A/201 6	PRS	140	70	65±36	-	0-9	5.8±2.6	4.6±2.7	3.5±3.1	3.0±2.8	42±15	22±20	2 yrs
Ahn S.S/ 2016	Retrospective	66	34	53.71±8.49	15- 167	15.65±4. 80	7.50±0.9 3	4.74±1.08	2.32±1.0 1	2.91±0.67	25.00±2.4 9	10.68±2.67	1 yrs
Lee J-S/ 2017	Retrospective	83	48	-	-	-	8.15±0.6 5	5.15±0.90	2.52±1.2 5	2.85±1.09	44.98±2.3 7	16.98±4.13	12- 54 mont hs

Table1B: Comparison of clinical outcomes of PELD and OLM for LDH.

PELD: percutaneous endoscopic lumbar discectomy, OLM: open lumbar microdiscectomy, f/u: follow up, op-time: operative time, min: minute, hosp stay: hospital stay, VAS: visual analogue scale, ODI: Oswestry Disability Index, pre-op: preoperative, post-op: postoperative, imp: Improvement (the difference between preoperative and postoperative score), neg: negligible, yrs: year, PRS: Prospective Randomized Study.

DISCUSSION

OLM was a gold standard surgical procedure for management of LDH. However open microdiscectomy required large incision for optimal vision. Throughout the operation, the paraspinal muscle retracted partial laminectomy, yellow ligament and facet joint removed. This method could cause instability and epidural scarring that result to clinical symptoms in greater than 10 percent of patients (1, 5). Percutaneous endoscopic discectomy was described in 1986 (22). When compared with open microdiscectomy, potential advantage of PELD include: (a). Can perform under local anesthesia (b). Less trauma to muscle (c). Rapid recovery and (d). Low cost (7, 17). A review of the comparison between PELD and OLM shows that PELD was superior (23). Therefore it is necessary to compare the clinical effectiveness and safety of these two procedures for treatment of LDH. We reviewed the effectiveness of procedure by evaluating improvement in pain, functional score, operative time and hospital stay and also safety by evaluating complication and recurrence of LDH in these two procedures. Many author mention that in PELD,

shorter operating time, less blood loss, shorter hospital stay which results from less resection of muscle, ligament and lamina in this technique when compare to OLM. Many studies reported similar surgical outcome. Above mention studies, I found, in these studies PELD less traumatic surgical procedure. Hence significant short term benefit to the patients. Firstly , short hospital stay and early return to work could benefit to economy cost and secondly most of patient suffer from LDH are old people and with medical co-morbidities, suggest short operating time and less bleeding important factor for reduce postoperative complications and recovery. In these review, the functional outcome similar in both PELD and OLM group regarded as VAS and ODI score. So we can conclude PELD and OLM effective procedure for the treatment of LDH.

These studies had variable complication after surgery, which include dural tear, nerve injury, discitis, dysesthesia, hematoma, infection, *cerebrospinal fluid* (CSF) leakage and so on. When PELD compared with OLM, PELD magnifies the operative field with high resolution camera that help surgeon to identify and protect nerve tissue. According to published literature table 2. In PELD group has lower complication rate than OLM group. Kim M-J et.al (19) reports, in PELD, 3 patients dural tear, 4 patients dysesthesia, 2 patients discitis and in OLM group 6 patients dural tear, 2 patients dysesthesia, 2 patients diskitis, 1 patient infection and 1 patient hematoma. As well as re-operation rate is 28 (9.5%) patients in PELD group and 38 (6.3%) patients in OLM group. In 2009 Ruetten et.al (18) reports in PELD 1 patient dural tear,3 patients dysesthesia and 1 patient transient urinary retention and in the OLM group 2 patients dural tear, 7 patients dysesthesia, 2 patients transient urinary retention,1 patient haematoma, 2 patients delay wound healing and 2 patients infection. As well as 3 patients in PELD and 2 patients in OLM which required revision surgery. In previous year 2008, Ruetten et.al (16) reports 3 patients dysesthesia in PELD group and in OLM group 5 patients dysesthesia, 2 patients post-op bleeding, 1 patient delay wound healing, 1 patient infection and 3 patients urinary retention. Whereas no serious complication seen in both groups like dural tear, nerve injury and discitis. As well as recurrence occur in 6 cases in PELD and 5 cases in OLM. All patients were re-operated in same technique. Gibson J.N.A et.al (21) reports 2 patients in PELD had headache post operatively may be due to dural tear and CSF leakage that last within 12 hours with bed rest and 4 patients had mild dysesthesia which settle in 2-4 weeks. Whereas, 1 OLM patient had persistent foot drop. Revision surgery was required in 5 cases in PELD and 2 cases in OLM, in which 4 patients had recurrence and 1 patient had re-herniation in PELD and 2 patients in OLM group had revision surgery without any known pathology. Choi K-C et.al (7) reports no serious complication in both groups. In PELD group 1 case underwent revision surgery and 1 case experience recurrence and in OLM group 1 case went anterior lumbar interbody fusion (ALIF) due to instability. Mayer H.N et.al (17) reports 1 patient had mild paresthesia. In PELD, 3 patients had unsuccessful surgery. Hence patients underwent revision open microsurgery. In OLM group 1 patient had re-operation and subsequently develop spondylodiscitis. Ahn S-S et.al (5) reports complication occurred in 4 patients in PELD group and 4 patients in OLM group. In PELD 2 cases dysesthesia, 1 patient headache, 1 patient pseudocyst. In OLM group 2 cases dysesthesia, 1 patient dural tear, 1 patient epidural hematoma where as in PELD, 2

patients had incomplete disc removal. No patient underwent re-operation due to patient's preference and treated with conservative management. Reherniation occurred in 1 patient in PELD and 1 patient in OLM at 12 months. Patient in the PELD group treated with conservative management and patients in OLM group underwent revision surgery with OLM technique. Lee D.Y et al (10), reports in PELD 1 patient persistent leg pain due to residual disc fragment. In OLM, 2 patients dural tear and 1 patient voiding difficulties and dysesthesia. As well as second recurrence in 1 patient PELD and 3 patients in OLM groups. One patient from each group underwent mini transforaminal lumbar interbody fusion (TLIF) for second recurrence and other 2 patients managed conservatively. Lee J.S et al (20), reports no patient with dural tear and OLM had 7 patients as well as 1 patient infection and 1 patient hematoma. In PELD 1 patient with surgery related neurological symptom and OLM had 4 patients. Whereas second reherniation encountered in 2 patients from PELD and 7 from OLM in which repeated PELD was conducted for PELD and fusion surgery for OLM.

In these 9 studies, total 1667 patients of LDH in which 669 patients underwent PELD and 998 patients underwent OLM surgery for LDH. I found, the complication rate 0.047% and recurrence rate 0.028% in PELD and in OLM complication rate 0.061% and recurrence rate 0.016%. The complication rate little higher in OLM compare to PELD as well as PELD had quite higher recurrence and reoperation rate than the OLM as shown in the (table 2) due to steps of learning curve of PELD and underestimate the existing pathology of LDH (19). However there's no significant difference in complication, recurrence and reoperation rate between these two groups.

Author	S.S	PELD				OLM					
		Nu.	TCN	complication	TRN	Recurrence & Re-operation	Nu.	TCN	Complication	TRN	Recurrence & Re-operation
Mayer H.M /1993	40	20	1	1 pts mild paresthesia.	3	3 pts unsuccessful surgery & went revision surgery.	20	-	-	-	1 pts re-operation subsequently develops spondylodiscitis.
Kim M.J/ 2007	902	295	9	3 pts dural tear, 4 pts dysesthesia & 2 discitis.	-	Re-operation rate 28(9.5%) case.	607	12	6 pts dural tear, 2 dysesthesia, 2 discitis, 1 infection & 1 hematoma.	-	Reoperation rate: 38(6.3%).
Ruette nS/ 2008	178	91	3	3 pts dysesthesia.	6	6 case recurrence & re-operated in same technique	87	12	5 pts dysesthesia, 2 pts post operative bleeding, 1 pts delay wound healing, 1 pts infection & 3pts urinary retention.	5	5 case recurrence and re-operated in same technique.
Lee D.Y/ 2009	54	25	1	1 persistent leg pain	1	Recurrence 1 case & underwent revision mini TLIF surgery.	29	3	2 pts dural tear, 1 pts voiding difficulty & dysesthesia.	3	3 pts recurrence & 1 pts underwent TLIF.
Ruette nS/ 2009	161	81	5	1 pts dural tear, 3 dysesthesia & 1 transient urinary retention.	-	3 pts required revision surgery.	80	16	2 pts dural tear, 7 dysesthesia, 2 transient urinary retention, 1 haematoma, 2 pts delay wound healing & 2 pts infection.	-	2 pts required revision surgery.
Choi K.C/ 2016	43	20	-	-	1	1 pts revision surgery & 1 pts experience recurrence	23	-	-	-	1 pts went ALIF.
Gibson J.N.A/ 2016	140	70	6	4 pts mild dysesthesia & 2 pts headache.	5	5 case revision surgery in which 4 pts recurrence & 1 pts reherniated.	70	1	1 pts persistent foot drop.	-	2 case revision surgery.

Table 2: Comparison of complication, re-occurrence and re-operation rate between PELD and OLM for LDH.

S.S: Sample size, Nu: Number, TCN: Total complication number, TRN: Total Recurrence number, PELD: percutaneous endoscopic lumbar discectomy, OLM: open lumbar microdiscectomy, LDH: lumbar disc

herniation, pts: patients, TLIF: Transforaminal lumbar interbody fusion, ALIF: anterior lumbar interbody fusion, pts: patients.

CONCLUSION

There are similar favorable functional outcomes from PELD and OLM for the management of LDH. But comparatively PELD are superior to OLM for less blood loss, short hospital stay, short operative time, mean disability period, usually less complication and less traumatization. Therefore PELD is a feasible alternative for OLM in the treatment of LDH. The case study is limited, need to study more cases and need long-term results for standardization of technique.

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