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Case Series

Short term results of endoscopic discectomy in lumbar spine

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ABSTRACT

A recent modification to lumbar discectomy involves the use of a micro-endoscope instead of an operating microscope for visualization. Percutaneous endoscopic lumbar discectomy (PELD) uses a rigid operating spinal endoscope that allows direct visualization and excision of contained and non-contained herniated disc fragments. The advantages of Endoscopic lumbar discectomy are remarkable due to minimal bone resection, no damage to paravertebral muscles, rapid recovery, minimally procedure related morbidity, cost-effectiveness and high patient satisfaction rate. Aims and objectives is to study and evaluate clinical and radiological outcomes of endoscopic lumbar discectomy over a period of 6 months.24 patients underwent endoscopic lumbar discectomy proven with MRI in a span of 3 years from 2018 to 2021. Every patient was followed up for 6 months in an observational, retrospective and prospective type of study and assessed on the basis of MacNab criteria, VAS pain score, Oswestry low back pain questionnaire. Mean preoperative Oswestry disability score (ODS) was 74.38 while mean postoperative ODS was found to be 29.25. Preoperative, while analyzing through Macnab criteria, poor results were seen in 95.83% of patients while fair results were seen in 4.17% of patients. Postoperatively excellent results were seen in 16.67% of patients while good results were seen in 83.34% of patients. Mean preoperative VAS was 7.33 while mean postoperative VAS was found to be 2.91. Endoscopic discectomy is a safe and effective procedure where patient satisfaction and pain relief are not compromised. It may be an effective and alternative treatment option for the upward migration of disc herniation in the upper lumbar area and offers additional advantage for early mobilization and faster improvement.

Keywords: Endoscopic discectomy, Lumbar disc, Radiculopathy, Disc herniation

INTRODUCTION

Lumbar disc herniation (LDH) is a major cause of back pain and sciatica. Degenerative lumbar foraminal stenosis is a common cause of lumbar radiculopathy, accounting for approximately 8-11% of lumbar degenerative diseases requiring surgical procedures.[1] The circumferential narrowing of the space available for the exiting nerve root leads to back pain and radicular symptoms.

When conservative treatment of symptomatic LDH with radiculopathy fails, lumbar microdiscectomy is the gold standard for treatment. A recent modification to lumbar discectomy involves the use of a micro-endoscope instead of an operating microscope for visualization. PELD uses a rigid operating spinal endoscope that allows direct visualization and excision of contained and non-contained herniated disc fragments. With advanced modification, PELD is reliable and comparable to conventional microdiscectomy.[2] However, this modified technique involves a steep learning curve, and in cases of high-grade migration, it is technically limited.

In general, MIS strives to offer equivalent or better surgical outcomes compared to open surgery, while minimizing the surgical "footprint." The cascade of events following a minimally invasive approach should ultimately reduce postoperative pain, minimize narcotic reliance, encourage early ambulation, reduce the incidence of complications, and reduce hospital length of stay (LOS) and reducing healthcare costs.

Spengler introduced a limited discectomy that removes extruded disc fragments and any loose pieces in the disc space. Spengler's method is referred to as conventional microdiscectomy (MD). Automated open lumbar discectomy (AOLD) was first introduced by James C. Thomas during the 6th annual meeting of international intradiscal therapy society (IITS) in 1993.[2] AOLD using the Micro IITM nucleotome kit (Clarus Medical, LLC, MN, USA) has been developed for minimally invasive discectomy, enabling surgeons to selectively decompress the herniated disc via an annular hole that is less than 3 mm in diameter preserving most of the posterior spinal structure.

Endoscopic lumbar discectomy, which is frequently termed as PELD, is rapidly evolving alternative for LDHs. The advantages of endoscopic lumbar discectomy are remarkable due to minimal bone resection, no damage to paravertebral muscles, rapid recovery, minimally procedure related morbidity, cost-effectiveness and high patient satisfaction rate. Initial cases of discectomy were limited to soft paracentral disc herniations. However, with time, numerous literatures have been published describing the efficacy of endoscopic lumbar discectomy for central disc herniations, highly migrated discs, foraminal and extraforaminal discs etc. Endoscopic lumbar discectomy has been reported to be efficacious in almost every form of disc herniations. Central disc herniations, in particular, have been notorious due to the internal disc derangement that already exists on presentation and partly due to the technical difficulty in addressing these conditions.[3]

Aims and objectives

Aims and objectives were to study and evaluate clinical and radiological outcomes of endoscopic lumbar discectomy over a period of 6 months.

CASE SERIES

This was an observational, retrospective and prospective type of study for the patients operated during the period 2018-2021.

Duration of the study carried 3 years

Per patient time given: 6 months

Sample size was calculated using the formula:

$$N=Z^2 \times p^\wedge(1-p^\wedge)/\varepsilon^2$$

$$N'=\frac{n}{1}+Z^2 \times p^\wedge(1-p^\wedge)/\varepsilon^2 N$$

n=sample size

E=margin of error [percentage in decimal form]=20% [0.20], Z=z score=1.96 for 95% confidence interval 78.

The z score is the number of standard deviations a given proportion is away from the mean. To find the right z score to use refer the table below (Table 1).

Table 1: Desired confidence interval.

Desired CI	Z score
80%	1.28
85%	1.44
90%	1.65
95%	1.96
99%	2.58

Sample size was calculated using Openepi version 3.1.

For the population of one lakh with 20% absolute precision and 95% confidence interval, sample size is 24 (Table 2).

Table 2: MacNab criteria.

Results	Criteria
Excellent	No pain; no restriction of mobility; return to work and original level of activity
Good	Occasional non- radicular pain; return to modified work
Fair	Some improved functional capacity; still handicapped and unemployed
Poor	Continued objective symptoms of root involvement; additional operative intervention needed at the index level

Inclusion criteria

All patients (20-60 years) with history of radiating pain in leg with or without low back pain which could be due to Lumbar protruded disc, extruded disc or sequestrated disc.

All these patients must give consent to be a part of the study to prevent loss of follow up, otherwise they won't fulfil inclusion criteria.

Exclusion criteria

Spine trauma (fracture or dislocation at any level), rheumatoid arthritis, infective etiology, tumors of spine at any level were excluded from the study.

All the patients were operated in the same institute by the same team of doctors with the same set of instruments and machines with same post operative course.

Transforaminal endoscopic lumbar discectomy (TELD)

In the TELD, discectomy and decompression are performed through intervertebral foramen between exiting and traversing root so before going in depth of TELD we need to know anatomy of intervertebral foramen (IVF). IVF is bounded by two mobile joints, zygapophyseal joints posteriorly and intervertebral disc anteriorly, because of mobility of two joints dimension of IVF change dynamically with movement of spine and with age related degeneration. Roof and floor are formed by inferior and superior notch of respective vertebral pedicles, medial wall by thecal sac and lateral wall by a facial sheath and overlying psoas muscle. Content of IVF are spinal nerves (combined dorsal and ventral roots in root sheath with dorsal root ganglia), dural sheath and its watershed area as it continues with epineurium of spinal nerve, lymphatics, spinal branch of segmental artery, communicating veins between internal and external vertebral venous plexus, sin-uvertebral nerves (two to four) and the fat surrounding these structures.

Crux of TELD is precise insertion of needle into the disc through safe triangle of Kambin's which lies between the exiting and the traversing root (Figure 1).

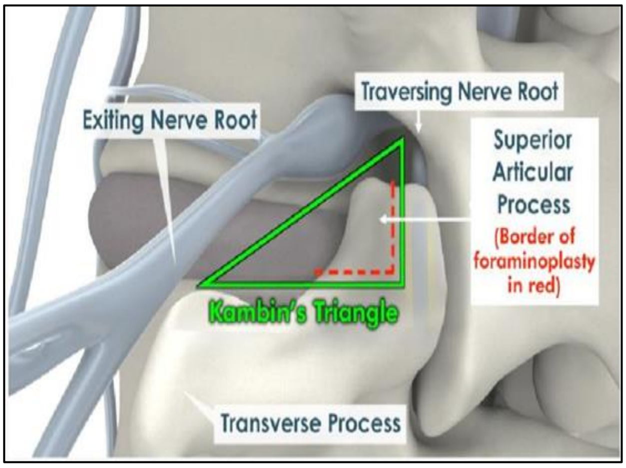

Figure 1: Kambin's triangle.

The pedicle and respective disc space chosen as radiographic landmark during percutaneous procedures. The point of needle insertion in radiographic view divided into vertical lines at medial, mid and lateral pedicular lines and horizontal line draw parallel to end plates in anteroposterior view and posterior vertebral line in lateral view 1. The medial pedicular line and posterior vertebral line are commonly used reference point for most of the transforaminal procedures (Figure 2).

The patient is positioned prone with support of chest and pelvis to free the abdomen. True lateral and anteroposterior (AP) fluoroscopy is mandatory and should preferably be carried out with minimal manipulation of the C arm. The SAP should be visualized clearly before draping. Both SAPs should project as one on the lateral view. The endplates of the adjacent vertebral bodies should also project as one. PTED is performed under conscious sedation so that patient can give feedback during surgery.

Skin incision is marked 8-13 cm from midline depending on level of surgery L4-L5 is marked 10 cm from the midline, while for L5-S1 incision is marked 12 cm from midline.[10] Preop planning of the trajectory on MRI is always needed to approach the herniated disk in a straight line. In case of L5-S1 disk herniation a preoperative X-ray is preferred to evaluate the height of the iliac crest in reference to the disk space of L5-S1 (Figure 3).

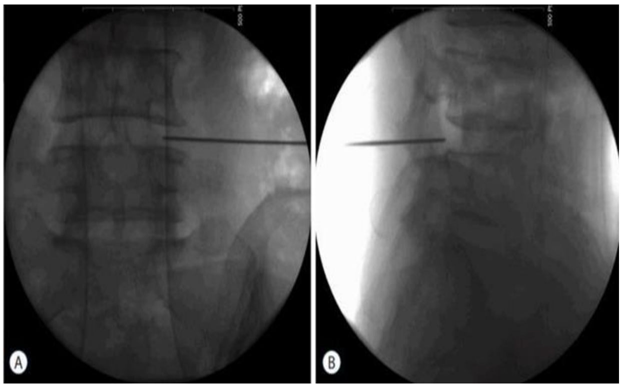

Figure 2: Needle positioning in AP and lateral projection.

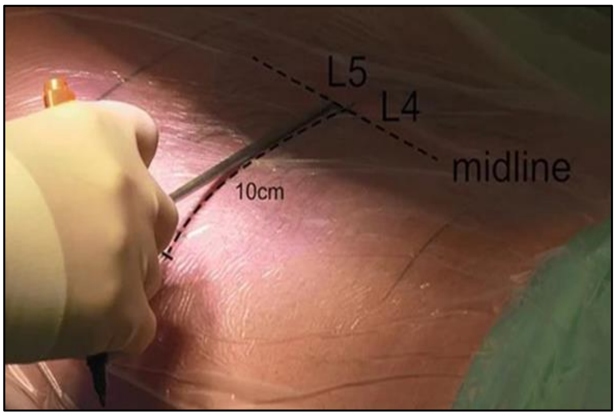

Figure 3: Clinical landmark for entry.

The 18-G needle is introduced and the level and direction of the needle to the SAP is checked with true AP and lateral view images (Figure 4).

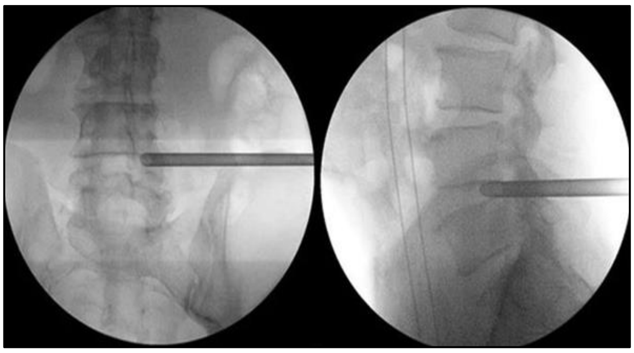

Figure 4: Cannula positioning in AP and lateral projections.

Drilling through the SAP in the direction of the disk is started with a 4-mm disposable drill. In this trans articular approach, the foramen is then widened up to 8 or 9 mm with different reusable drills with a blunt tip in order to prevent damage to neuronal structures. The working channel is anchored in the drilled bony trajectory. The opening of the working channel is directed to the dura. Hereafter, the 30° angled endoscope is introduced, and proper position of the camera is checked. A pressure regulated pump is used for rinsing with 9% saline. Now, loose tissue and disk fragments are removed gently. The evaluation of the amount of decompression is debatable but concluded sufficient when there is a clear increase of pulsations of the dura or when there is a clear view of a pulsating nerve root.

Interlaminar approach (Figure 5).

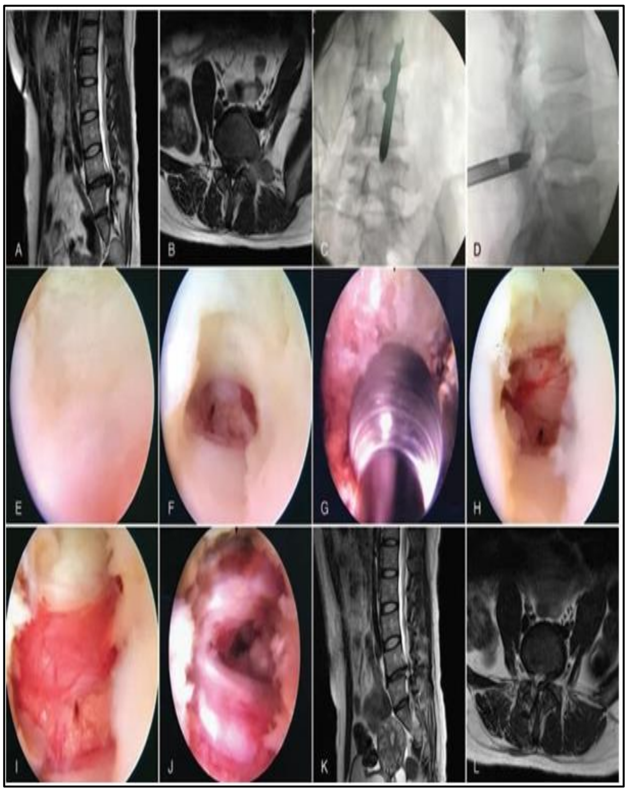

Figure 5 (A-L): Procedure of full-endoscopic discectomy via interlaminar approach performed in 32-year-old female patient diagnosed with LDH at L4-L5. Preop MRI shows LDH at L4-L5. Intra-op anteroposterior and lateral fluoroscopy to confirm interlaminar space, expose ligamentum flavum, ligamentum flavum incised, cranial lamina resected by direction-variable drill, Dural sac exposed, cranial lamina partial resected with Dural sac and herniated disc exposed, Dural sac, traversing nerve root, and axilla after decompression, MRI 10-14 days after surgery shows herniated lumbar disc decompressed.

Indications of the study included positive straight leg raising test, radiating pain with or without neurological deficits, leg pain is more severe than back pain, sufficient conservative (non-surgical) treatment of at least 6-8 weeks in form of rest, pain killers, back strengthening exercises, selective nerve root block, acute disc herniation with progressive motor deficit or if radiological examination findings correlate with the clinical symptoms and signs.

Contraindications include extensive calcification of disc, spinal canal and foraminal stenosis (relative contraindication) or spondylolisthesis.

Oswestry low back pain disability questionnaire (Table 3).

Table 3: Oswestry low back pain disability questionnaire.

Score	Disability	Interpretation
0-20%	Minimal	Patient could cope with most living activities. Usually, no treatment was indicated apart from advice on lifting sitting and exercise.
20-40%	Moderate	Patient experienced more pain and difficulty with sitting, lifting and standing. Travel and social life were more difficult and they might be disabled from work. Personal care, sexual activity and sleeping were not grossly affected and the patient could usually be managed by conservative means.
40-60%	Severe	Pain remains the main problem in this group but activities of daily living were affected. These patients required a detailed investigation.
60-80%	Crippled	Back pain impinges on all aspects of the patient's life. Positive intervention required.
80-100%	Bed-bound	Either bed-bound/ exaggerating their symptoms.

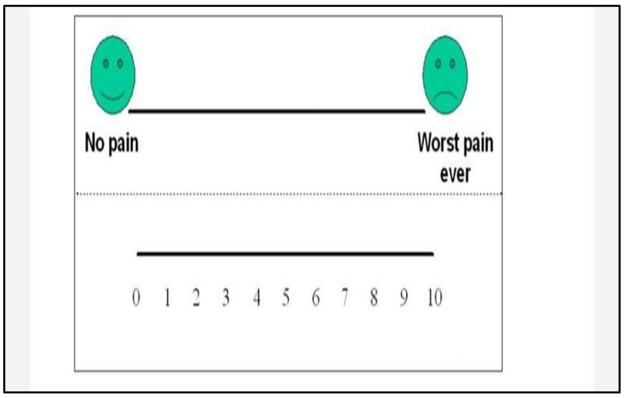

Figure 6: VAS scale.

Outcome of the study was as follows

Quantitative data were represented as their mean ± SD. Categorical and nominal data were expressed in percentage. The t test was used for analysing quantitative data and categorical data was analysed by using chi square test. The significance threshold of $p<0.05$.

The 29.17% of the patients belonged to the age group of 31 to 40 years while 25 percent of the patients belonged to the age group of 41 to 50 years. 12.5% of the patients belonged to the age group of 51 to 60 years and more than 60 years respectively. Mean age of the patients was 42.92 years (Table 4).

Table 4: Age-wise distribution of patients.

Age group (In years)	N	Percentage (%)
≤30	4	16.67
31 to 40	7	29.17
41 to 50	6	25
51 to 60	3	12.5
More than 60	3	12.5
Total	24	100
Mean ± SD	42.92 ± 13.12	

The 58.33% of the patients were males while the remaining were females (Table 5).

Table 5: Gender-wise distribution of patients.

Gender	N	Percentage (%)
Males	14	58.33
Females	10	41.67
Total	24	100

L4-L5 disc prolapse was the diagnosis in 50% of the patients. In 25 percent of the patients, diagnosis was L5-S1 disc prolapse. L3-L4, L4-L5, L5-S1 disc prolapse and L3L4-L5 disc prolapse was seen in 4.17% of the patients each while L4-L5, L5-S1 disc prolapse was seen in 16.67% of the patients (Table 6).

Table 6: Distribution of patients according to diagnosis.

Diagnosis	N	Percentage (%)
L4-L5 disc prolapse	12	50
L4-L5, L5-S1 disc prolapse	4	16.67
L5-S1 disc prolapse	6	25
L3-L4, L4-L5, L5-S1 disc prolapse	1	4.17
L3L4-L5 disc prolapse	1	4.17
Total	24	100

Preoperatively, 100% of the patients were crippled according to ODS. When assessed postoperatively, it was seen that 75% of the patients were of moderate grade when assessed by ODS while 16.67% of the patients showed excellent results according to ODS. Severe results were seen in 8.33% of the patients according to ODS. While analyzing statistically, significant improvement was seen in terms of ODS (Table 7) (Figure 7).

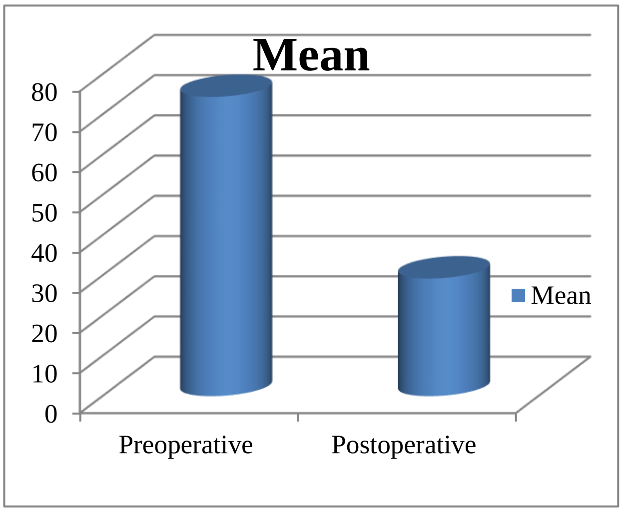

Figure 7: Comparison of pre-operative and postoperative ODS.

Table 7: Distribution of patients according to ODS.

ODS	Preoperative		Postoperative	
	N	**%**	**N**	**%**
Minimal	0	0	4	16.67
Moderate	0	0	18	75
Severe	0	0	2	8.33
Crippled	24	100	0	0
Total	24	100	24	100
P value	0.000 (Significant)			

Mean preoperative ODS was 74.38 while mean postoperative ODS was found to be 29.25. While comparing statistically significant results were obtained (Table 8).

Table 8: Comparison of pre-operative and postoperative ODS.

ODS	Preoperative	Postoperative
Mean	74.38	29.25
SD	4.48	7.99
P value	0.0001 (Significant)	

Preoperative, while analyzing through Macnab criteria, poor results were seen in 95.83% of the patients while fair results were seen in 4.17% of the patients. Postoperatively, while analyzing through Macnab criteria, excellent results were seen in 16.67% of the patients while good results were seen in 83.34% of the patients. While comparing preoperative and postoperative results statistically, significant results were obtained (Table 9) (Figure 2).

Table 9: Comparison of outcome according MacNab criteria.

MacNab criteria	Preoperative		Postoperative	
	N	%	N	%
Excellent	0	0	4	16.67
Good	0	0	20	83.34
Fair	1	4.17	0	0
Poor	23	95.83	0	0
Total	24	100	24	100
P value	0.000 (Significant)			

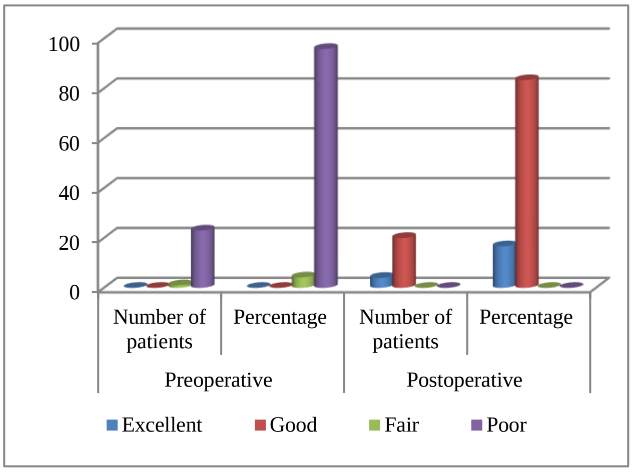

Figure 8: Comparison of outcome according MacNab criteria.

Mean preoperative VAS was 7.33 while mean postoperative VAS was found to be 2.91. While comparing statistically significant results were obtained (Figure 9).

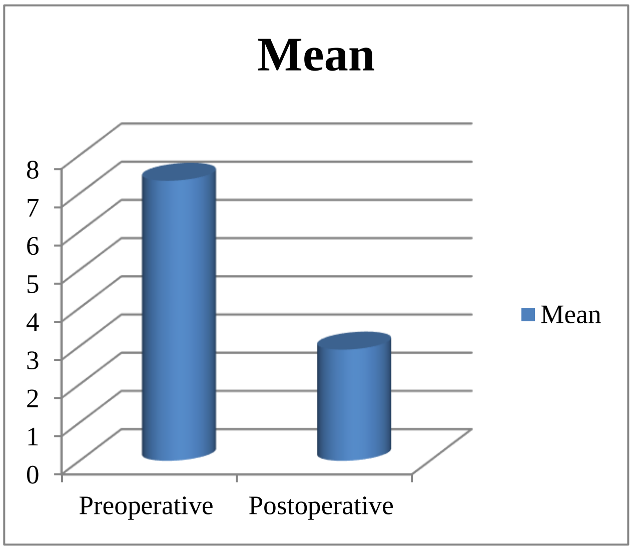

Figure 9: Comparison of pre-operative and postoperative VAS.

When assessed postoperative radiologically, disc herniation and nerve compression were seen in 4.17% of the patients each (Table 10).

Table 10: Postoperative radiological outcome.

Radiological outcome	N	Percentage (%)
Disc herniation	1	4.17
Nerve compression	1	4.17

DISCUSSION

Yasargil and Casper and Williams started the use of microscopes for posterior discectomy which limited the skin incision and less muscle and epidural scarring.[4-6] Patients had less postoperative pain, early rehabilitation, and early return to work. Any disc pathology along with elements of bony lateral stenosis can be dealt with this approach. Ever since then, microdiscectomy has become a gold standard procedure.

Mayer et al in their study two groups of patients with contained or small non contained disc herniations were treated by either PELD (20 cases) or microdiscectomy (20 cases).[7] The disc herniations were located at L2-3 (one patient), L3-4 (two patients), or L4-5 (37 patients). There were no significant differences between the two groups concerning age and sex distribution, preoperative evolution of complaints, prior conservative therapy, patient's occupation, preoperative disability, and clinical symptomatology. Two years after PELD, sciatica had disappeared in 80% (16 of 20 patients), low-back pain in 47% (nine of 19 patients), sensory deficits in 92.3% (12 of 13 patients), and motor deficits in the one patient affected. Two years after microdiscectomy, sciatica had disappeared in 65% (13 of 20 patients), low-back pain in 25% (five of 20 patients), sensory deficits in 68.8% (11 of 16 patients), and motor deficits in all patients so affected. Only 72.2% of the patients in the microdiscectomy group had returned to their previous occupation versus 95% in the PELD group.

Nakagawa et al et al reviewed 30 patients who underwent MED and compared their outcome with that of patients subjected to the conventional method.[8] Laboratory data suggested that MED was less invasive surgery. Moreover, MED allowed an early return to work.

Destandu et al analysed the contribution of endoscopic surgery for lumbar foraminal disc herniation in a series of 191 patients.[9] All the patients underwent a posterior paramedian endoscopic procedure performed by the same operator between April 1999 and March 2002. Outcome was assessed with a self-administered questionnaire. Prolo's criteria were used. Of the 191 patients, 144 questionnaires (75%) were returned showing results were excellent in 130 (90%), good in 1 (0.7%) and poor in 13 (9%). The complications observed were: aseptic discitis (n=1); approach of two levels due to incorrect fluoroscopic guidance (n=2); Dural tear (n=1); partial nerve root lesion (n=3); a second operation was necessary in 4 patients but only once at the same level and on the same side. Of the 80 patients who were working before the operation, 77 were able to return to work with an average delay of 3 weeks, 2 did not return to work and one worked only part time.

Li et al compared between micro-endoscopic discectomy (MED) and open decompression discectomy, and assess the clinical value of MED.[7] Two hundreds and sixty-one cases who suffered from LDH had a retrospective study. One hundred and twenty-one of 261 patients were treated with MED, the segment of herniated discs was at L4-5 in 66 and at L5S1 in 58. The other 137 patients were treated with decompression by fenestration and, the segment of herniated discs was at L4.5 in 64 and at L5S1 in 73. MED was performed via scope. Open decompression discectomy was performed decompression by fenestration and discectomy. MED group, the operative time was (85±15) minutes and blood loss was (50±10) ml, time of lying in bed after operation was (50±8) hours. Open decompression group, operative time was (60±15) minutes and blood loss was (80±20) ml, time of laying bed after operation was (150±24) hours. MED group needed significantly less narcotic medication after operation than open decompression group. According to modified Macnab criteria, the results were excellent in 94, good in 25, fair in 5 in MED group and excellent in 101, good in 28, fair in 8 in open decompression group.

Liu et al performed in consecutive patients with LDH treated with PLD (n=129) or MED (n=101) in a single hospital from January 2000 to March 2002.[11] All patients were followed up with MacNab criteria and self-evaluation questionnaires comprising the ODI and medical outcomes study 36-item short-form health survey. A total of 104 patients (80.62%) with PLD and 82 patients (81.19%) with MED were eligible for analyses, with a mean follow-up period of 6.64±0.67 years and 6.42±0.51 years, respectively. According to the MacNab criteria, 75.96% in the PLD group and 84.15% in the MED group achieved excellent or good results, respectively, this was statistically significant (p=0.0402). With the ODI questionnaires, the average scores and minimal disability, respectively, were 6.97 and 71.15% in the PLD group and 4.89 and 79.27% in the MED group. Total average scores of medical outcomes study 36-item short-form health survey were 75.88 vs 81.86 in PLD group vs. MED group (p=0.0582). The cost and length of hospitalization were higher or longer in MED group, a statistically significant difference (both p<0.0001). Long-term complications were observed in two patients (2.44%) in the MED group, no such complications were observed in the PLD group.

Jhala et al evaluated technical problems, complications, and overall initial results of micro-endoscopic discectomy.[12] All patients with single nerve root lesions including sequestrated or migrated and selected central disc at L4-5 and L5-S1 were included. All patients were operated by a single surgeon with the Metrx system (Medtronics). The 97 were operated by 18- mm ports, and only three patients were operated by 16- mm ports. The mean follow up was 12 months (range 3 months-4 years). Open conversion was required in one patient with suspected root damage. Preoperatively single facet removal was done in 5 initial cases. Minor Dural punctures occurred in seven cases and root damage in one case. The average surgical time was 70 min (range 25-210 min). Average blood loss was 20-30 ml. Technical difficulties encountered in initial 25 cases were insertion of guide pin, image orientation, perioperative dissection and bleeding problems, and reaching wrong levels.

Eun et al investigated the outcomes of PELD in terms of clinical and radiographic findings and revision surgery rate.[13] Sixty-two patients who underwent PELD 10 years previously were contacted for follow-up. Clinical parameters such as the visual analogue scale scores for the back and legs (VAS-B and VAS-L, respectively), the ODI, and radiographic findings such as the disc-height ratio and change in the difference between flexion and extension were recorded and compared to the preoperative values. For 62 followed patients, 38 met our inclusion criteria (35 transforaminal, 3 interlaminar). For the remaining 38 patients who had no further surgery, the postoperative VAS-B (2.53±1.98), VAS-L (1.82±1.92), and ODI (12.69±11.26) were significantly different from the pre-operative values (8.45±1.52, 7.40±3.04, and 55.33±24.63, respectively; all p=0.01). The average disc-height ratio was 81.54% of the original disc height. There was no evidence of instability after long-term postoperative follow-up.

Mahesha et al analyzed the clinical outcome, quality of life, neurologic function, and complications.[14] One hundred patients with lumbar disc prolapse who were treated with PELD. The outcome was assessed using modified Macnab's criteria, VAS, and ODI. The mean follow-up period was 2 years (range 18 months-3 years). Transforaminal approach was used in 84 patients, interlaminar approach in seven patients, and combined approach in nine patients. An excellent outcome was noted in ninety patients, good outcome in six patients, fair result in two patients, and poor result in two patients. Minor complications were seen in three patients, and two patients had recurrent disc prolapse. Mean hospital stay was 1.6 days.

Ahn et al evaluated the long-term clinical outcomes of TELD and to determine the factors predicting favourable outcome.[15] Five-year longitudinal data of 204 consecutive patients who underwent TELD were collected. Outcomes were assessed using the VAS pain score, ODI, patient satisfaction rating, and the modified Macnab criteria. The mean VAS score for leg pain improved from 7.64 at the baseline to 1.71, 0.81, 0.90, and 0.99 at postoperative 6 weeks, 1 year, 2 years, and 5 years, respectively (p<0.001). The mean ODI improved from 67.2% at the baseline to 15.7%, 8.5%, 9.4%, and 10.1% at postoperative 6 weeks, 1 year, 2 years, and 5 years, respectively (p<0.001). The overall patient satisfaction rate was 94.1%. Based on the modified Macnab criteria, 83.8% of patients had excellent or good results. Transforaminal endoscopic lumbar discectomy offers favorable long-term outcomes with minimal tissue damage. Postoperative pain and functional status may change over time.

Othman et al evaluated clinical, functional, and surgical outcomes of PELD in patients with LDH.[16] The 15 patients who presented with single-level, posterolateral, L4-5 or L5-S1 LDHs underwent PELD within a mean follow-up period of 10.6 months. There were 10 male patients and five female patients with the mean age of 35.9 years. The mean amount of intraoperative bleeding was 98.67 ml. The mean operative time was 124 minutes. The mean postoperative hospital stay was 33.6 hours. The mean preoperative VAS of LBP was 6.13 and that of RP was 6.73. Postoperatively, the mean VAS of LBP became 1.6 and that of RP was 1.6. Patient satisfaction score according to modified MacNab's criteria was excellent in 80% and good in 20%.

Huang et al compared the safety and effectiveness of PETD versus PEID for the treatment of LDH.[17] A total of 13 trials with 974 cases consisting of 3 randomized controlled trials, 3 prospective studies and 7 retrospective studies were included. The results suggest that patients treated with PEID experienced more significant advantages with shorter operation time, less intraoperative blood loss and less intraoperative fluoroscopy times but more complications than those treated with PETD; however, the two operative approaches did not significantly differ in terms of LDH recurrence, hospital stay, (ODI) scores, VAS scores, Japanese orthopaedic association (JOA) scores and MacNab criteria at the final follow-up.

CONCLUSION

Endoscopic discectomy is a safe and effective procedure where patient satisfaction and pain relief are not compromised. It may be an effective and alternative treatment option for the upward migration of disc herniation in the upper lumbar area and offers additional advantage for early mobilization and faster improvement.

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