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Analysis of functional outcome of single and double level lumbar discectomy

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Keywords
lumbar PIVD,
functional outcome,
RODI,
RDQ,
BQ

ABSTRACT

Introduction: Functional improvement in lumbar PIVD patients can be assessed either objectively like improvement in SLRT, relief in pain, etc or subjectively using different types of scales. In our study, we have used Revised Oswestry Disability Index (RODI) score, Ronald–Morris disability questionnaire (RDQ), The Back Bournemouth Questionnaire (BQ) to analyse functional outcome in single and double level lumbar PIVD patients pre-operatively and post-operatively.

Method: It is a prospective study including 80 patients of lumbar PIVD who failed to respond to conservative treatment. Patients were clinically evaluated and disability scales viz- RODI, RDQ & BQ were recorded. After lumber discectomy, patients were again assessed and scored as per disability scales at 1 month, 6 months and 1 year postoperatively.

Result: RODI, RDQ and BQ scores were calculated at pre-operatively and post-operatively 1, 6 and 12 months and statistically analysed. The mean RODI scores at pre-operative and postoperative 1, 6, and 12 months were 72, 18, 10, and 6 respectively. The mean RDQ scores at pre-operative and postoperative 1, 6, and 12 months were 15, 5, 3, and 2 respectively. Similarly, the mean BQ scores at pre-operative and postoperative 1, 6, and 12 months were 51, 12, 8, and 4 respectively. Statistically, significant improvement was seen in mean scores of all 3 functional scales and maximum changes were observed after 1 month. Statistically, significant improvements were observed in 54 out of 62 patients (87%). Three questions of BQ related to the patient social and family activities, anxiety and depression were separately compared pre and post-operatively and they showed a statistically significant improvement.

Conclusion: Overall 87% of patients had a significant improvement in functional assessment using RODI, RDQ and BQ scales. On comparing single and double level discectomy patients, the functional improvement was similar in follow up of one year. Social and family activities (SFA), depression and anxiety of the patients improved significantly over 1 year.

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Introduction

Lumbar disc prolapse has been thoroughly evaluated in terms of its epidemiology [14], physiology [33] and outcome after discectomy [22, 26, 34]. Proper patient selection and surgical technique can provide an excellent outcome. Different discectomy procedures are carried out for the treatment of lumbar disc prolapse. Postoperatively 75-90% of patients get relief from radicular pain [4,5,9,17,20,21].

According to Asch et al, in a prospective study of 200 patients, the outcome was significant, which was determined by six parameters including pre-operative ODI (Oswestry disability index) and the ODI at 1 and 10 days, 6 weeks, and 6 months and 12 months postoperatively. One of the most common causes of the poor outcome is the poor definition of selection criteria for surgery, which varies fourfold to fivefold between different communities and countries [3].

Risk factors associated with poor outcome include work off over 3 months, psychosocial problems including poor educational level, smoking, and obesity (30). According to Weber's study, the first symptom to improve following successful surgery is the radicular pain, typically followed by improvement in motor function, and finally the resolution of sensory loss. Sensory loss may be permanent persisting at 10-years follow-up in 35% of patients [31, 32].

The restoration of normal function after discectomy in lumbar PIVD patients is considered a key outcome. Assessment of functional improvement can be done either objectively, like improvement in SLRT, relief in pain, improvement in movement, or subjectively with the help of different types of scales. Functional assessment scales are comprised of a self-reported questionnaire and having a standardised format that yields a measure with known reliability and validity. Thus, we performed our study to analyse the functional outcome after lumbar discectomy using the Revised Oswestry Disability Index (RODI) score, Ronald–Morris disability questionnaire (RDQ) and The Back Bournemouth questionnaire (BQ). We are also comparing the degree of improvement after single and double level lumbar discectomy along with the effect of surgery on SFA, depression and anxiety.

Methodology

This prospective study was conducted in the Department of Neurosurgery at our institute between February 2017 to September 2018. Eighty patients with symptoms and signs of lumber PIVD, diagnosed as a case of single and double level Lumbar PIVD by Magnetic resonance imaging (MRI) were enrolled in the study after informed consent. The study was approved by the institutional ethical committee.

Inclusion criteria:

- Signs and symptoms of lumbar PIVD correlating with MRI findings.
- Not responding to conservative management of 6 weeks or more.
- Needs Primary Lumbar Discectomy without fusion.

Exclusion criteria:

- Previous spinal surgery.
- More than 2 level discs prolapsed.
- Lumbar disc prolapsed associated with spondylolisthesis or severe degenerative disease.
- The patient having red flag signs.

- spinal fractures
- primary malignancy, metastasis or infection
- cauda equine syndrome or severe neurological compromise

- Intra-op complications – Dural tear, root injury.

Patients were clinically evaluated and disability scales viz- RODI, RDQ & BQ were recorded. After lumber discectomy, patients were again assessed and scored as per disability scales at 1 month, 6 month and 1 year postoperatively.

Data were summarised as MEAN ± SE (standard error of means). Groups were compared by repeated measures One-way analysis of variants (ANOVA) and the significance of the mean difference between the groups were compared by Tuckey's HSD (honestly significant difference) post hoc test. A two-tailed p-value < 0.05 was considered as statistically significant. The analysis was performed on STATA software.

Functional Status Questionnaires: The following functional status questionnaires, completed by the patients, were taken into account for this study. The

researcher was present during the measurements (at pre-op, post-op 1 month, 6 months, and 1 year) to help patients complete the questionnaires.

Functional status questionnaires:
1. Revised Oswestry disability index (RODI): The Oswestry Disability Index is an index derived from the Oswestry Low Back Pain Questionnaire used by clinicians and researchers to quantify disability for low back pain.

This validated questionnaire was first published by Jeremy Fairbank et al. in Physiotherapy in 1980. The self-completed questionnaire contains ten topics. Each topic category is followed by 6 statements describing different potential scenarios in the patient's life relating to the topic. The patient then checks the statement which most closely resembles their situation. Each question is scored on a scale of 0–5 with the first statement being zero and indicating the least amount of disability and the last statement is scored 5 indicating the most severe disability. The scores for all questions answered are summed and then multiplied by two to obtain the index (range 0 to 100). Zero is equated with no disability and 100 is the maximum disability possible.

Scoring:
- 0% –20%: Minimal disability
- 21%–40%: Moderate Disability
- 41%–60%: Severe Disability
- 61%–80%: Crippling back pain
- 81%–100%: These patients are either bed-bound or have an exaggeration of their symptoms

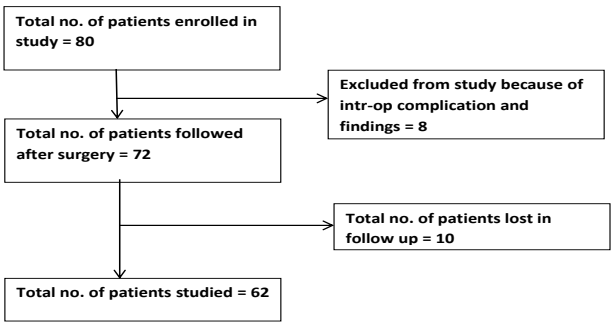
2. The Roland-Morris Disability questionnaire (RDQ) contains 24 yes/no items. Patients are asked whether the statements apply to them that day (the last 24 hours). The RDQ-24 score is calculated by adding up the number of "yes" items, ranging from 0 (no disability) to 24 (maximum disability). The clinical improvement over time can be graded based on the analysis of serial questionnaire scores. Total improvement can be reflected as a percentage of initial score.

3. The Back Bournemouth questionnaire (BQ) is a comprehensive multi-dimensional core outcome tool assessing patients' outcomes of care in a routine clinical setting. It is a short, self-report questionnaire, developed by J. Bolton. The questionnaire consists of seven core items, which are: pain intensity, function in activities of daily living, function in social activities, anxiety, depression levels, fear-avoidance behaviour and locus of control behaviour. Each item is rated on a numeric rating scale (NRS) from 0 to 10:
0= Much better
5= no change
10= much worse.

The score for each measure is added. This can produce a value between a minimum score of 0, and a maximum score of 70. A higher score reflects a higher degree of impact on a patient's life.

Results

Out of 80 patients, 10 patients were lost in the follow-up, 5 patients showed intra-operative mobility which needed stabilization, two patients had post-op foot drop and one patient had intra-operatively CSF leakage due to Dural tear. After exclusion of these patients, 62 patients were studied.



Post-operative CT scan, 6

Out of 62 patients, 47 (76%) patients were male and 15 (24%) were female. Age ranged between 22 years to 63 years. The mean age was 38.8± 9.88 years (mean±SD). Thirty-four (55%) patients had history of insidious onset of pain and twenty-eight (45%) patients had history of sudden onset pain. Patients were categorised into 4 categories based on the duration of pain i.e. <3 months, 3 months – 1 year, 1year- 3 years and > 3 years. Twenty (32%) patients had complaints of radicular pain for less than 3 months, fourteen (26%) had pain since one year, thirteen (21%) patients had history of pain since 3 years and fifteen (21%) patients had pain for more than 3 years. Knee reflex was decreased in 4 (6%) and normal in 58 (96%) patients but ankle reflex was

decreased in 59 (95%) and normal in 3 (5%) patients. plantar reflex was absent in 45 (73%), equivocal in 13 (21%), absent in 2 (3%) and normal in 2 (3%) patients. 31 (50%) patients had paraspinal muscle spasm on examination. 7 (11%) had lumbosacral scoliosis because of unilateral pain and muscular spasm. Out of 80 patients, 60 (97%) had positive straight leg raising test (SLRT) while 2 (3%) had negative SLRT. 25(40%) patients had bilateral positive SLRT whereas 17 (27%) patients had left-sided positive SLRT and 18 (29%) patients had right-sided positive SLRT (Table 1).

Table 1. Clinical parameters of patients

Parameter		No. of patients
Age profile of the study population		
Number of cases		62
Sex	**Male**	47
	Female	15
Minimum age (years)		22
Maximum age (year)		63
Mean age ± SD		38.80 ± 9.88
Clinical parameters		
Occupation	Light work	20
	Moderate work	19
	Heavy work	23
Pain onset	Insidious	34
	Sudden	28
Duration	< 3 month	20
	3month- 1year	14
	1year - 3 year	13
	>3 year	15
Knee reflex	Normal	58
	Decrease	4
Ankle reflex	Normal	3
	Decrease	59
Planter reflex	Normal	2
	Decrease	2
	Equivocal	13
	Absent	45
Paraspinal muscle spasm	Present	31
	Absent	31
Spinal deformity (scoliosis)	Present	7
	Absent	55
SLRT	Positive	25+17+18 (B/L+LT+RT)
	Negative	2

Out of 62 patients, 27 (44%) patients were diagnosed as a case of L4-L5 PIVD, 27 (44%) patients had L5-S1 PIVD and 8 (12%) patients had both L4-L5, L5-S1 PIVD. At L4-L5 disease level, 15 patients had Central disc herniation, 5 had right paracentral and 7 had left paracentral disc herniation on MRI lumbosacral spine. Out of 27 L5-S1 PIVD patients, 19 had Central disc herniation, 10 had right paracentral disc herniation and 8 had left paracentral disc herniation (Table 2).

Table 2. Level of disease and methods of surgery

Parameter		No. of patients
L4—L5 PIVD	Central	15
	RT Paracentral	5
	LT Paracentral	7
	Total	27
L5-S1 PIVD	Central	19
	RT Paracentral	10
	LT Paracentral	8
	Total	27
L4-L5, L5-S1		8
Method of Discectomy	Open	41
	Microscopic	18
	Endoscopic	2
	Percutaneous	1

Patients underwent different types of discectomies that are by open method, microscopic endoscopic, and percutaneous. Open laminectomy and discectomy were performed in 41 (66%) patients. Microscopic, endoscopic and percutaneous discectomies were performed in 18 (29%), 2 (3%) and one (2%) patient respectively (Table 2).

The mean RODI scores at pre-operative and postoperative 1, 6, and 12 months were 72, 18, 10, and 6 respectively. The mean RDQ scores at pre-operative and postoperative 1, 6, and 12 months were 15, 5, 3, and 2 respectively. Similarly, the mean BQ scores at pre-operative and postoperative 1, 6, and 12 months were 51, 12, 8, and 4 respectively. A one - way repeated measures ANOVA was run on the 62 patients to determine, if there were any changes in the mean RODI, RDQ, BQ scores over time (pre-op; post-op at 1 month, 6 month, and 1 year) (figure 1 and 2). Results showed that there was a statistically significant difference in the mean RODI, RDQ, BQ scores over time that is pre-op vs post-op 1 month, 6 month, and 1 year period ($p=0.000$). Tukey's post-hoc test revealed no statistically significant differences between the RODI, RDQ, BI scores observed 1-month post-op vs 6-month post-op, and 6-month post-op vs 1-year post-op ($p>0.05$). However, a statistically

significant difference was observed between mean RDQ scores 1-month post-op vs 1-year post-op (p=0.013), whereas, mean RODI and BQ scores 1-month post-op vs 1-year post-op were statistically non-significant (Table 3).

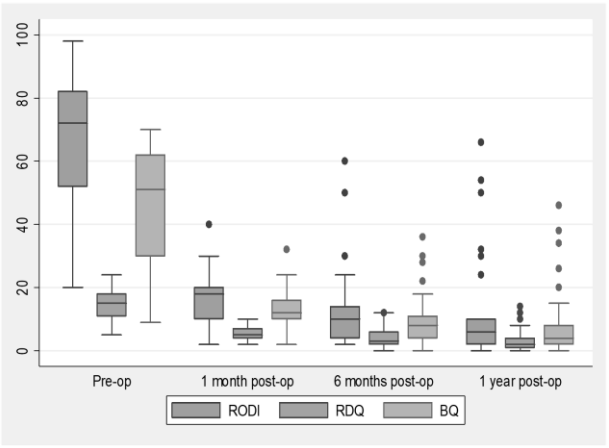


Figure 1. Changes in RODI, RDQ, BQ scores and their mean

Table 3. Pre-op versus post-op changes in different functional score system

Changes in Mean RODI Scores in Single/ Double Level Discectomy patients			
Time	**Contrast**	**S.D**	**Tukey p-value**
1 month post-op vs pre-op	-54.516	2.73	0.000
6 month post –op vs pre-op	-54.064	2.73	0.000
1 year post-op vs pre-op	-55.000	2.73	0.000
Changes in Mean RDQ scores in single/ double level discectomy patients			
1 month post -op vs pre-op	-9.032	0.654	0.000
6 month post –op vs pre-op	-10.322	0.654	0.000
1 year post-op vs pre-op	-11.032	0.654	0.000
Changes in Mean BQ scores in single/ double level discectomy patients			
1 month post-opvs pre-op	-34.516	2.142	0.000
6 month post –op vs pre-op	-37.484	2.142	0.000
1 year post-op vs pre-op	-38.612	2.142	0.000

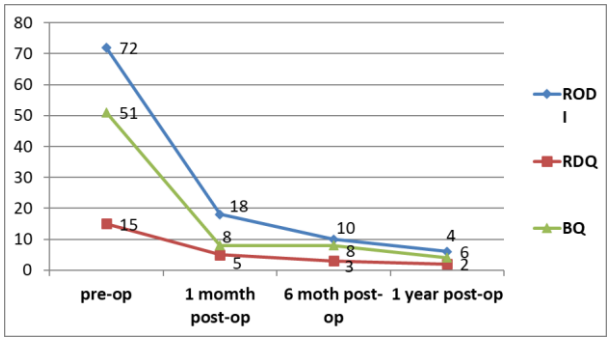


Figure 2. Mean of ODI, RDQ and BQ

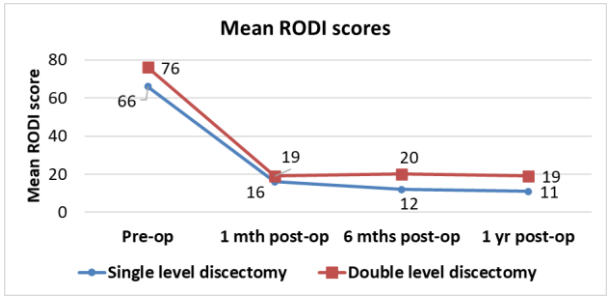


Figure 3. Changes in mean of RODI scores in single level vs double level discectomy patients

Patients were categorised in 2 categories based on the level of discectomy performed, i.e single level discectomy (SLDG) and double level discectomy (DLDG). In SLDG patients (n=54), the mean RODI scores were 65.67±2.76, 16.18±1.06, 11.92±1.58, and 10.95±2.05, at pre-operative, and postoperative 1month, 6 month, 1 year respectively. Similarly, the mean RDQ scores were 14.42±4.79, 5.38±2.38, 4.11±3.16, 3.44±3.64, and mean BQ score 46±18.10, 12.35±6.11, 9.16±8.01, 7.85±10.63 at pre-operative and respective post-operative follow up. In DLDG patients (n=8), the mean RODI scores were 75.75±5.57, 18.75±3.42, 19.50±7.87, and 18.87±9.10, at pre-operative, and postoperative 1month, 6 month, 1 year respectively. Similarly, the mean RDQ scores were 15.63±4.0, 6.62±3.11, 5.20±3.73, 4.25±5.03 and mean BQ score 50.38±16.12, 14.63±8.19, 13.12±12.73, 13.25±17.99 at pre-

operative and respective post-operative follow up (figure 3, 4 and 5). Changes in RODI, RDQ, and BQ scores at the respective intervals were compared between these two groups using a mixed ANOVA test. The difference of change in RODI, RDQ, and BQ scores over time in both groups was found to be statistically non-significant (P=0. 701, P=0.992, P=0.962 respectively). This finding showed that a similar degree of improvement occurred in both SLDG and DLDG.

Sub questions of BQ related to patient's anxiety, depression, social, and family activities (SFA) were compared pre-operatively and post-operatively. The mean ± S.D SFA scores at pre-operative and post-operative at 1 year were 7.65 ± 2.26 and 3.32±1.40 and this difference was statistically significant (P=0.000) (Table 4 and Figure 6).

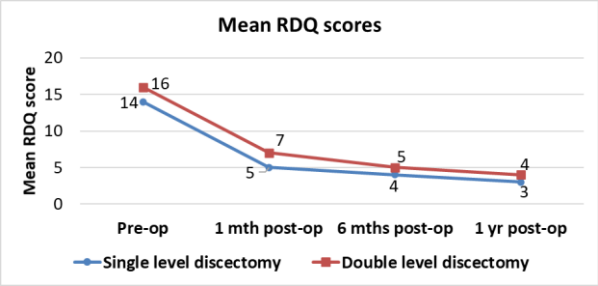


Figure 4. Changes in mean of RDQ scores in single level vs double level discectomy patients

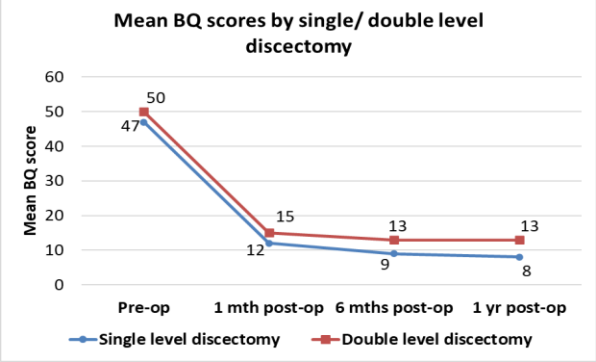


Figure 5. Changes in mean of BQ scores in single level vs double level discectomy patients

Table 4. Changes in psychosocial status (sub-questions of BQ)

Sub-question of BQ	Pre-op		Post-op		p-value
	Mean of diff.	S.D	Mean of diff.	S.D	
Social and family activities	7.650	2.26	3.32	1.40	0.000
Anxiety	5.50	2.53	1.42	1.37	0.000
Depression	5.50	2.53	0.71	1.08	0.000

Similarly, the pre and 1 year post-op anxiety scores were 5.73 ± 2.53 and 1.42± 1.37 respectively and the difference was statistically significant (P=0.000). The pre-op and 1 year post-op depression scores were 5.50 ± 2.53 and 0.71± 1.08 respectively and the difference was statistically significant (P=0.000) (Table 4 and Figure 6).

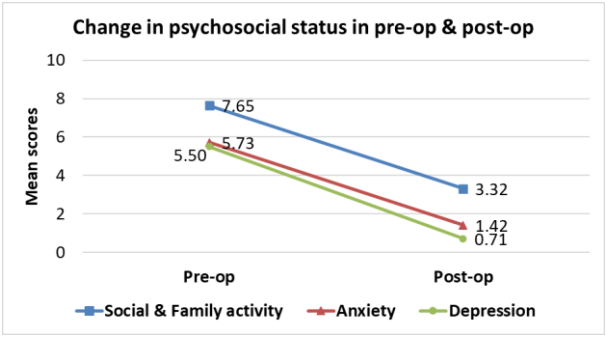


Figure 6. Changes in psychosocial status (sub question of BQ)

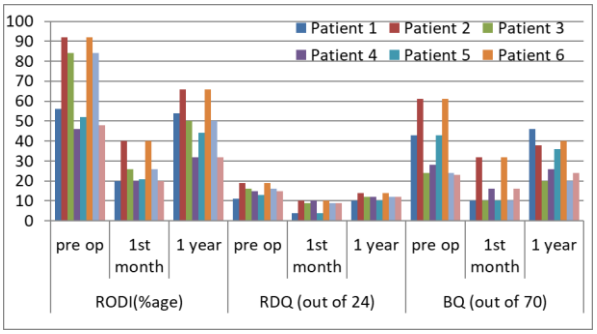


Figure 7. Functional assessment of not significantly improved patients

Discussion

Patients were assessed functionally with RODI, RDQ, and BQ at admission and after surgery at 1 month, 6 months, and 12 months. The RODI scores at pre-operative, post-operative 1, 6, and 12 months were 72, 18, 10, and 6 respectively. The RDQ scores at pre-operative, post-operative 1, 6, and 12 months were 15, 5, 3, and 2 respectively. Similarly, the BQ scores at pre-operative, post-operative 1, 6, and 12 months were 51, 12, 8, and 4 respectively. A gradual statistically significant improvement was seen in mean scores of all 3 functional scores. Maximum changes were observed after 1 month follow up in most of the patients as mentioned in the statistical table and diagram (Table 2 and Figure 1). Pre-

operative functional scores of each patient were compared with post-operative scores separately and the result showed that gradual, statistically significant improvement seen in 54 (87%) patients and 8 (13%) patients did not show statistically significant improvement, after the initial decrease in scores (figure 7). Among the patients who did not show improvement, four patients were in the RODI category 5 and 4 patients were in RODI category 3 pre-operatively. These patients were evaluated with MRI lumbosacral spine and among these two patients had developed Spondylolisthesis at operated level, four patients had foraminal stenosis due to facet joint hypertrophy and two patient's MRI showed increase degenerative changes at the operated level. Among two patients those who had developed post-op listhesis, one patient had undergone L4-L5 discectomy through open method and another patient had undergone L4-L5, L5-S1 double level discectomy (Table 5).

Table 5. MRI findings in patients not showing significant improvement

Spondylolisthesis	**2**
Foraminal stenosis	4
Canal stenosis	2

Many previous studies measured functional assessment with the help of different tools like SF-36, SF-24, PROLO scores, ODI scores or self-made objective criterias of improvement and many other [1,2,8,10,11,12,15,18,23,25,27,28,29]. Joel N Abramowitz categorized patient's outcome into 3 groups Good, Fair & Poor. A good outcome was defined as a situation where the patient had returned to the premorbid level of activity and was not limited by residual symptoms and was not taking narcotic medications. A fair outcome was defined as a situation where the patient did not return to work or was taking narcotic medications but improved after surgery. A poor outcome was defined as a situation where the patient had no improvement. In his study of 108 patients, 72 patients showed Good outcome, whereas 34 patients showed fair and 2 showed poor outcome [19]. Lewis et al (1987) divided the outcome as completely relieved, same or worse. 100 patients were followed for 5 - 10 years [16]. The results of lumbosacral Discectomy appeared favourable as compared to Weber's study [31, 32]. In the study of Junge et al - out of 381 patients 89% and 86% were followed up for 6 months and 12 months respectively. Low back pain of 6 or more on Visual Analog Scale, reduced working ability of more than half a year, no return to the previous job, regular visits to treating physicians, or hospital stay have been chosen as a criteria for the bad outcome. The outcome was categorized into good, moderate, and bad. Good- None of the above-mentioned criteria, Moderate -one or two of the criteria if back pain is between 0 and 3. Bad - Two criteria and back pain more than 3 or all of these criteria. 51.5% had a good outcome, 28.4% moderate, and 20.11 % bad outcome at 12 months follow up. There was no difference in 6 months outcome and 12 months outcome [13]. It is evident from above that for analyzing the outcome of lumbar disc disease various authors have chosen criteria that differ from study to study and the duration of follow up also differs significantly. These assessments were done by clinicians, so functional assessment of patients can be overestimated. That's why in our study, the functional assessments of the patients were done with the help of RODI, RDQ, AND BQ scores. These questionnaires were filled by patients themselves; hence there were chances to plot their functional assessment in a better way. Our results were comparable to other studies.

Most of the long term studies with follow up of more than 5 years are retrospective and most of the short term studies with short follow up of 2 years and less are prospective. Studies with short term follow up showed better outcomes than long term results. Further studies that included patients with severe degenerative spine or with neurological deficit showed unsatisfactory results. Salenius and Laurent reported satisfactory early results in 70% of patients that was decreased to 56% after 6 to 11 years of observation[24]. Frymoyer et al, in a retrospective study with a minimum 10-year follow-up, reported a 38% failure rate because of persistent symptoms or the need for reoperation [7]. Dvorak et al found that 23% of patients still complained of severe low-back pain and 45% had residual sciatica after 4 to 17 years follow-up [34]. In Spangfort's analysis of 2504 patients, more than 30% of patients complained of persistent low back pain, while sciatic pain was found in 23% of the patients [26].

Single and double level discectomy patients were compared along with changes in the mean of RODI, RDQ, and BQ scores over the defined follow-up time. Both groups of patients showed significant improvement over time. Further, both these groups were compared to see the degree of improvement over 1 year with the help of difference in the mean RODI, RDQ, and BQ scores measured at pre-operatively and one-year postoperatively and both these groups showed a similar degree of improvement (figure 3, 4, and 5).

Some patients of lumbar disc disease had anxiety and depression and some patients had affected their social and family activities. Hence 3 questions of BQ related to the patient social and family activities, anxiety and depression were separately compared pre and post-operatively. Mean of differences of means at pre-op and post-op 1 year of these sub-questions showed the statistically significant improvement over time. (Table 4 and Figure 6)

Complication:

Four patients experienced complications in our study. The intra-operative cerebrospinal fluid leak was present in one patient due to a dural tear, two patients had unilateral post-operative foot drop, and 1 patient developed postoperative superficial wound infection (Table 6).

Table 6. Complications

Complication	No of patients
CSF leak due to dural tear	1
Post-op foot drop	2
Superficial wound infection	1

Limitations:

This is a single centred study so the study population is less. Follow up period is one year as this is a prospective study and having time limitation. Further, prospective study is needed, which include large sample size and long follow up period so the results can be better plotted on population.

Conclusion

87% (n= 54) of patients had statistically significant improvement on functional assessment scales i.e RODI, RDQ, and BQ. Most of the patients who did not show statistically significant improvement were in ODI category 4 or 5. No statistically significant differences were seen on comparing single and double level discectomy on follow up of one year i.e similar trends of improvement were seen in single level versus double level discectomy patients. SFA, depression, and anxiety of the patients improved significantly over 1 year.

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Abbreviations

ODI: disability index
PIVD: prolapsed intervertebral disc
RODI: revised Oswestry Disability Index score,
RDQ: Ronald–Morris disability questionnaire
BQ: The Back Bournemouth questionnaire
MRI: Magnetic resonance imaging
ANOVA: One-way analysis of variants.
HSD: honestly significant difference
SE: standard error of means.
SLRT: straight leg raising test
SLDG: single level discectomy
DLDG: double level discectomy
SFA: social and family activities

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