Outcome of Surgical Decompression in Simple Degenerative Lumbar Canal Stenosis.

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ABSTRACT

Introduction: A sensory or motor deficit occurs in about half of patients with symptomatic lumbar canal stenosis. There is no study evaluating neurologically deficient patients with simple degenerative lumbar canal stenosis using validated measures and there are no consensus about outcome predictor of surgical decompression is available in literature. Only one study assessed outcome of patients with neurological deficit but it had not excluded either patients with comorbid conditions that affect outcome or those with lumbar canal stenosis secondary to spondylolisthesis and scoliosis. The aim of this study was to assess overall result and to compare the surgically treated patients of simple degenerative lumbar canal stenosis using validated outcome measures like Oswestry Disability Scale (ODS), Neurogenic Claudication Score (NCS), Visual Analogue Scale (VAS) and Satisfaction, this study also aimed to find outcome predictor of surgical decompression.

Methods: This was a retrospective comparative study with homogenous cohorts with control of comorbid conditions that affect outcome. Each cohort(Those with neurological deficit and without neurological deficit) had 11 patients who had adequate decompression with laminectomy and foraminotomies. Outcome was evaluated using validated ODS, NCS, VAS and Satisfaction in overall and also evaluated by each section of ODS, NCS with appropriate statistical analysis of both cohorts.

Results: Neurologically deficient patients had more back pain, tingling, numbness, weakness and heaviness preoperatively. In neurologically deficient patients there was a trend to have poorer outcome, but overall recovery rate was higher than neurologically normal patients. Sensory deficit did not recover. The index surgery may not have effect on sitting and sleeping in both cohorts and may not have effect on lifting in neurologically normal patients and may not have effect on social life in neurological deficient patients. Additionally the index surgery may not have effect in relieving symptoms of numbness, tingling and heaviness and weakness in neurologically normal patients and may not have effect on standing in both cohorts. Recovery according to VAS was higher in neurologically normal patients. Preoperative NCS and preoperative heaviness and weakness severity contributed up to 43 % in ODS recovery rate.

Conclusion: Overall there is a trend to have poorer outcome in neurologically deficient patients though recovery rate is better than neurologically normal patients. Recovery in term of VAS is better in neurologically normal patients. Preoperative NCS and preoperative heaviness and weakness severity score predict or contribute up to 43 % in ODS recovery rate.

Keywords: simple degenerative lumbar canal stenosis; decompression; preoperative neurologic deficit; clinical outcome; outcome predictor.

INTRODUCTION

Lumbar canal stenosis is the most frequent indication for spinal surgery in patients older than 65 years of age. [1] Patients usually present with a variable syndrome of back and leg pain and often also with sensory disturbance, motor weakness and voiding disturbance. A sensory or motor deficit occurs in about half of patients with symptomatic lumbar stenosis.[2]

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There are no universal indicators of outcome after decompression surgery in lumbar canal stenosis and also little known about factors that predict the outcome of surgery. In a study [3] no association was found between neurological impairment and outcome measures consisting of walking capacity, symptom severity and satisfaction, however this study had not excluded patients with comorbid predictors [4] which are likely to confound the outcome.

Primary outcome of surgery in term of Oswestry Disability Scale (ODS), Neurogenic Claudication Score (NCS) and secondary outcome in terms of Visual Analogue Scale (VAS), and Satisfaction in patients with simple degenerative lumbar canal stenosis without comorbid conditions is not known.

The aim of this study was to assess overall result and to compare the surgically treated patients of simple degenerative lumbar canal stenosis using outcome measures including ODS, NCS, VAS and Satisfaction, dividing them into 2 cohorts: first cohort which had objective preoperative neurological deficit with second cohort which did not have neurological deficit. Secondary aim was to find out predictor/ contributor of outcome as there is no consensus on predictor of outcome at present in the literature after surgical decompression in simple degenerative lumbar canal stenosis.

METHODS

All case records of the patients who are aged above 50 years and decompression done primarily for simple degenerative Lumbar Canal Stenosis (LCS) were included in this study. Documents of 65 patients with diagnosis of Lumbar Canal Stenosis (LCS) who were operated in Indian Spinal Injuries Center (ISIC) , New Delhi between 2003 and mid of 2007 were retrospectively reviewed. The diagnosis of LCS was based on treating surgeon's (HSC) assessment of appropriate symptoms, examination and radiodiagnostic findings (CT, MRI, NCS). Patients with complex LCS secondary to spondylolisthesis, scoliosis and achondroplasia were excluded. Surgery other than laminectomy, presence of cardiopulmonary comorbidities, neuromuscular comorbidities, presence of spinal problem in other level of spine, previous spinal surgery and preoperative radiological instability were also excluded from study.

Out of 65 cases, nine patients having lumbar canal stenosis secondary to spondylolisthesis, two patients having lumbar canal stenosis secondary to achondroplasia, eight patients of age younger than 50 years at presentation and 12 patients who satisfied other exclusion criteria were excluded from the present study. Out of 35 patients who were found "fit" for this study, Nine patients could not be traced due to wrong contact details, two did not answer outcome questionnaires at the latest follow up, 1 died after 10 weeks of surgery by cause other than from this surgery and there was1mismatch in response between NCS and ODI. For final evaluation we had only 22 patients. Eleven of 22 patients were found to have objective neurological impairment and they were grouped in one cohort (Group B) and remaining eleven patients who did not have neurological impairment were grouped in another cohort (Group A). For motor deficit, power less than or equal to 3 out of 5 according to MRC grading was taken into consideration. Decreased in Light touch sensation as compared to other normal part of the body was considered as sensory deficit.

All patients had an adequate lumbar decompression performed by a single surgeon (HSC). Decompression consisted of excision of spinous process, total laminectomy with extension of decompression laterally to relieve all compressed nerve root. Decompression was done at those levels where the posterior segments had significant pressure on the spinal cord as confirmed by the examination of patients' symptoms, signs and radiology. Patients having the same amount of back and leg pain also had postero-lateral fusion and stabilization with pedicle screw instrumentation. Three patients had bone graft and pedicle screw fixation in Group A and only one patient had the same in Group B.

Outcome was assessed using validated measures: ODS[5], NCS,[6,7] Standardized Satisfaction questionnaires[6,7] and VAS. ODS and NCS were assessed preoperatively and at the latest follow up and Standardized Satisfaction questionnaires was assessed at the latest follow up. Only 9 of 10 parameters of ODS were evaluated (sexual part not considered). Sexual part was also omitted from NCS. The total score in each primary outcome scale was cross checked to strengthen authenticity of response. When mismatched was found it was rectified by second interview. In case of mismatch even after second interview the patient was excluded from the study. General health status was assessed preoperatively and at the latest follow up using question no 1 of SF-36.[8] Patients were asked to rate their health as excellent, very good, good, fair and poor. At the latest follow up each patient was interviewed through telephone by one of the authors (MA) who was unaware of diagnosis of patients, the aim of the research and group of the

patients till all questionnaires were filled up.

Total scoring of ODI and NCS was done by conventional scoring system. In ODI 0 to 5 score system was used for each section, 0 means no disability and 5 means maximum disability. 0, 1,2,3,4 and 5 score were given for options a, b, c, d, e and f respectively. In NCS 0,2,4,6 score system was adopted for option a,b,c and d respectively. In NCS 0 means maximum disability and 6 means no disability. For calculation of VAS score in NCS, "Score = 10 - reported pain scale" formula was used.Patients who had deterioration in ODS (postoperative score more than preoperative score or less than 20 % recovery rate [9] were considered as poor outcome. The recovery rate was calculated as (Postoperative value- Preoperative value/Preoperative value) X 100 %. Later each options in each sections of ODI and NCS was encoded with 1 if response was a, 2 if response was b, 3 if response was c, 4 if response was d, 5 if response was e and 6 if response was f. Data was analyzed using Statistical Package for Social Sciences version 16.

RESULT

There were 11 patients in each group. The mean age was 64.81±7.2 years in group A and 65.36±5.9 years in group B. Age difference was not significant (p= 0.849) The male and female ratio was 3.6:1 and 2.2:1 in Group A and Group B respectively (Table 1). The mean follow up period was 25.45±16.9 months in Group A and 26.90±15.6 months in group B, ranging from the least of 7 months in Group A and 9 months in group B and the maximum of 54 months in Group A and 52 months in Group B. The difference between follow up durations in two groups was not significant (p=0.837).

Health status was similar in both groups preoperatively and postoperatively. (p=0.127 and 0.792). Health condition was slightly better in Group A preoperatively; however there was no much difference in health status postoperatively. There was significant improvement in health status in both groups postoperatively and more in Group B (p=0.018 and 0.001) (Table 2). Overall 4 patients (18.18%) had poor outcome based on ODS and Satisfaction. One patient (9%) from Group A and 3 patients (27.27%) from Group B had poor outcome. The average Preoperative ODS was 25.45±7.2 and 28.27±12.4 in group A and Group B respectively. The preoperative ODS was not statistically significant in two groups (p=0.522).The average postoperative ODS was 8.9±9.23 and 10.27±10.67 in Group A and Group B respectively. The average recovery rate was -75.43 ±15.35 % in group A and -80.13 ±17.10 % in group B when analysis was carried out not including 4 cases that had poor outcome. The recovery rate was not statistically significant in two groups (p=0.554).

Table 1. Demographic data

Variables	Group A (n=11)	Group B (n=11)	p- value
Age	64.81±7.2 Years	65.36±5.9 Years	**0.849**
Sex	8M/3F	6M/5F	
Follow up	25.45±16.9months	26.9±15.6 months	0.837
Surgery			
Decompression	72.70%	90.90%	
Decompression, Bone graft, Instrumentation	27.30%	9.10%	
Level			
L4-5	36.36%	36.36%	
L3-4,L4-5	18.18%	9.09%	
L4-5,L5-S1	9.09%	45.45%	
L2-3,L3-4,L4-5	9.09%	0%	
L3-4,L4-L5,L5-S1	18.18%	9.09%	
L2-3,L3-4,L4-5, L5-S1	9.09%	0%	

Table 2. Summary of Patients and Result

Variables	Group A (n=11)	Group B (n=11)	p- value
Preoperative Health Status			0.127
Excellent	18.18%	9.09%	
V. good	27.27%	9.09%	
Good	36.36%	36.36%	
Fair	18.18%	36.36%	
Poor	0%	9.09%	
Health Status At Latest Follow Up			0.792
Excellent	90.90%	72.72%	
V. good	0%	18.18%	
Good	0%	9.09%	
Fair	9.09%	0%	
Poor	0%	0%	
Preoperative VAS	8±1.78	8.45±1.36	0.511
VAS At Latest Follow Up	1.81±2.8	2.45±3.55	0.592
Average recovery rate	87.87%	86.5%	
Preoperative Oswestry Disability Score	25.45±7.2	28.27±12.4	0.522
Oswestry Disability Score At Latest Follow Up	8.9±9.23	10.27±10.67	0.752
Oswestry Disability Score recovery	-75.43±15.351% N=10	-80.13±17.106% N=8	0.55
Preoperative Neurogenic Claudication Score	31.63±9.5	20.81±16.94	0.080
Neurogenic Claudication Score At Latest Follow Up	78.81±19.5	68.45±31.04	0.360
Satisfaction			
Very successful, Complete relief	45.50%	36.45	
Fairly successful, a good deal of relief	45.50%	54.50%	
Not very successful, only a little relief	0%	0%	
Failure, no relief	9.10%	9.10%	
worse than before	0%	0%	
Satisfied	90.90%	72.70%	
Unsatisfied	9.10%	27.30%	

Table 3. Determinants of ODS recovery (n=22)

Variables	Beta value	t-value
Preoperative NCS	0.54 **	3.07
Preoperative Heaviness and weakness	-0.49 **	-2.79
Multiple R = 0.66 R square = 0.43		
** Significant at 0.01		

It was seen that Neurological deficient patients had slightly more preoperative severe symptoms and also had slightly more tendency to improve in function.

Preoperative NCS and preoperative heaviness and weakness severity score contributed up to 43 % in ODS recovery when analyzed with

multiple regression analysis (Significant at 0.01) (Table 3).

Among 35 patients initially included in this study, 51.42% had neurological impairment, 14.28% had decreased sensation, 22.85% had motor deficit and 14.28 % had mixed deficit. L4, L5 and S1 dermatomes and myotomes were involved as neurological deficit.

Among patients who completed follow up (22 patients) 50 % had neurological impairment, 22.72 % had only motor deficit, sensory and mixed deficit were 13.63 % each. None of patients who had only sensory deficit did improve after surgery. Improvement was noted in all patients who had mixed deficit and patients who had

Table 4. Neurological deficits

Neurological deficit	Preoperative deficit status %	Latest Follow up status %
When considered all 35 patients	51.42%	
Motor deficit	22.85%	
Sensory deficit	14.28%	
Motor+ sensory deficit	14.28%	
When considered only 22 patients from inclusion	50%	
Motor deficit	22.72%	40% improved, 40 % remained same, 20 % detiorated
Sensory deficit	13.63%	No recovery
Motor+ sensory deficit	13.63%	All improved

motor deficit had inconsistent result, 40 % improved, 40% remained same and 20% deteriorated. There was overall neurological improvement in 45.45% of patients (Table 4).

Preoperative ODS correlated with preoperative NCS (p=0.001). Preoperatively both groups had similar disability according to each section of ODI (p> 0.05). However there was a slight trend of having sleep disturbance due to pain in Group B (p=0.77). According to NCS, Group B patients had tendency to be more symptomatic than group A patients (p=0.08), they also had significant back pain (p=0.009), tingling, numbness (p=0.000) and weakness and heaviness in legs (p=0.001) preoperatively.

Lifting ability, sitting ability and sleeping activity were not improved (P=0.190, 0.127 and 0.134) by decompression in Group A as per ODS. Numbness tingling, heaviness and weakness and standing ability were not improved (p=0.341, 1, 0.147) in Group A after decompression as per NCS. No effect of treatment were seen in terms of sitting, sleeping and social life as per ODS in Group B (p=0.086, 0.065, 0.054). Sitting and standing ability were not changed with decompression in group B (p=0.058, 0.195) (Table 5).

The preoperative mean VAS score was 8 ± 1.78 and 8.45±1.36 in group A and Group B respectively. The

Table 5. Preoperative and latest follow up status of groups when analyzed by sections of ODS, NCS

Preoperative	ODS	NCS
Group A	ND	ND
Group B	Trend of having sleep < 6hrs (p=0.077)	More symptomatic (p=0.08) More back pain severity (p=0.009) More Tingling, Numbness severity (p=0.000) More weakness and Heaviness severity (p=0.001)
Latest follow up	ODS	NCS
Group A	No difference in Lifting (p=0.190) Sitting (p=0.127) Sleeping (p=0.134)	No difference in Numbness, tingling (p=0.341) Heaviness, Weakness (p=1) Standing (p=0.147)
Group B	No difference in Sitting (p=0.086) Sleeping (p=0.065) Social life(0.054)	No difference in Sitting (p=0.195) Standing (p=0.058)
ND= No difference ie. p> 0.05 in all sections of ODS and NCS		

difference was statistically insignificant (p=0.511). The postoperative score was 1.81±2.8 and 2.45±3.35 in Group A and Group B respectively. There was also no statistical difference (p=.592) in postoperative VAS between 2 groups. But the average recovery rate was 87.87% in Group A and 86.5% in Group B (Table 2).

All the patients except who had poor outcome were satisfied with surgery. 45.5% of group A and 36.4 % of Group B patients evaluated the index operation as "very successful and complete relief", 45.5% from Group A and 54.5 % of Group B patients evaluated as "fairly successful and a good deal of relief" and 9.1% of patients of each group evaluated as "failure and no relief". Overall 40.9% evaluated as very successful and complete relief ,50% evaluated as fairly successful and a good deal of relief and remaining 9.1% evaluated as failure and no relief (Table 2).

Among 22 patients six complications were noted in 5 patients: dural tear in 4 patients, deep infection in 1 patient and transient voiding difficulty in 1 patient who also had dural tear. Only 1 patient from group B had dural tear as complication and remaining 3 patients belonged to Group A. We also had complications like dyselectrolemia in 2 patients, urinary tract infection in 1 patient who could not be traced in the latest follow-up.

DISCUSSION

We used very stringent inclusion and exclusion criteria in this study. This is with a view to minimize the risk of confounding factors that affect in outcome as several previous studies already showed poor out come with these conditions. Aaito T and associates[4] found in the systematic review that depression, cardiovascular cormorbidity, disorder affecting walking ability was "specific" comorbid predictors. Other studies [10, 11, 12, 13] also noted that comorbid conditions were associated with greater complications and mortality as well as worse symptoms, function and satisfaction.

In this current study we have overall poor outcome (failure) of 18.18%. Surgical success rate is variable in literature. Most series report a 64% to 91% rate of improvement .[14] In a meta-analysis by Turner et al, "good to excellent" results vary as much as from 26% to 100% for surgically treated patients.[15,16]Our result is comparable to other result but it is seen that patients with preoperative neurological deficit have trend to have poor clinical outcome (failure 27% vs. 9% in patients who have no neurological deficit). As we had control over comorbidities and all patients had adequate decompression and adequate stabilization where deemed the poorer result in neurologically deficient may be due to different pathophysiology of sign and symptoms in neurological deficient patient. The pathophysiology of the back pain and radiculopathy associated with the lumbar canal stenosis is not yet clear and is very complex. Prolonged compression of nerve roots may result in intraneural fibrosis which despite decompressive intervention may be irreversible. In such instances, the severity of neurologic compression and duration of compression likely relate directly to inferior neurologic outcomes. However, this result may not be conclusive as it has small sample size but this result should arouse attention of treating doctor as well as patients of lumbar canal stenosis about the clinical outcome after surgery in neurological deficient patients and their timely operation before development of neurological deficit. It is important to consider this finding in countries where health service is not streamlined and where patients usually present late. This is the scenario of most of the developing and underdeveloped countries. It is not uncommon to see patients of degenerative lumbar canal stenosis with neurological impairment in addition to leg and back pain when they present late. This finding should be tested with another prospective study with large sample size.

Among 35 patients initially included in this study.51.42% had neurological impairment, 14.28 % had decreased sensation, 22.85% had motor deficit and 14.28 % had mixed deficit. Among 35 patients who completed follow up (22 patients) 50 % had neurological impairment, 22.72 % had motor deficit and sensory and mixed deficit were 13.63 % each. Louis and Nazarian[17] reported on their series of 350 patients and found that 37% had objective weakness. In literatures [18, 19, 20, 21] reported preoperative sensory deficit varies from 29% to 59% and motor deficit varies from 23 % to 49%. We have less sensory deficit as compared to other literature and motor deficit is comparable. However, we have also found deficit in mixed form, deficit in both motor and sensory in same patients. Neurological findings improve inconsistently after surgery.[22] Boghdady GW, El-Adl WA et al reported 41 % improvement in motor impairment and 21.6% improvement in sensory impairment. In a series reported by Guigui et al, only 30% had complete improvement in motor symptoms after laminectomy.[23] In this current study we found no improvement in sensory status in patients having only sensory deficit. But all patients with mixed deficit showed improvement. Only 40 % of patients having only motor deficit showed improvement. Why the result is different from peripheral recovery can be a

topic for research. What we know as of today about spinal nerve root is that spinal roots may be more susceptible to mechanical effects because of their lack of the perineurium and funicular plexus formation present in peripheral nerves and in long standing nerve compression nerve gets fibrosed. It may behave differently (different pathophysiology) which we do not know clearly at present.

While analyzing each sections of ODS and NCS, there were no difference between cohorts preoperatively in accordance with both ODS and NCS in Group A where as there was a trend of having sleep disturbance in group B patient in accordance with ODS and they were more symptomatic and had more back pain, tingling &numbness and also more weakness & heaviness in accordance with NCS. In neurological deficient patients chronic duration of compression and severity of compression of nerve may have resulted in different pathophysiology which is not clearly as of today.

The most common reported surgical complication was dural tear.[24, 25, 26, and 27] In this current study among 22 patients 6 complications were noted in five patients: minor dural tear in four patients, deep infection in one patient and transient voiding difficulty in one patient who also had dural tear. Malmi Vaara A and associates [24] reported on series of 50 patients eight perioperative complications: seven dural tear, one misplaced transpedicular screw and postoperatively four complications: One had neural dysfunction due to a peridural haematoma, one had misjudgement of stenotic level and in one case there was respiratory distress and another patient had restenosis after one year. Fokter S, yerby S et al[25] reported one dural tear, one postoperative haematomas, one postoperative seroma, two pedicle screw failure on the series of 58 patients. Wilby MJ and associates[26] had two dural tear, two postoperative wound infections in the series of 100 patients. Athiviraham A and associates [27,28] had dural tear in six patients on series of 88 patients.

Though we have small sample size because of stringent exclusion and inclusion criteria, this study has its own strength. Firstly it is age matched, sample size matched study and coincidently having homogenous group of cohorts, secondly it is comparative study, thirdly it has control over factors known to affect outcome, and lastly we used validated outcome measures and we also cross checked responses in primary outcome measures by statistical correlation to strengthen authenticity of response.

CONCLUSION

Overall there is a trend to have poorer outcome in neurologically deficient patients though recovery rate is better than neurologically normal patients. Recovery in term of VAS is better in neurologically normal patients. Preoperative NCS and preoperative heaviness and weakness severity score predict or contribute up to 43 % in ODS recovery rate.

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