| RESEARCH PAPER |

Optimizing Spinal Fusion in Degenerated Spinal Stenosis, Proposing a Hybrid Scoring System for Bangladeshi People in Low Back Pain

Md. Moshiur Rahman[1]*, Sabrina Rahman[2], Mohammad Nabil Hossain[3]
Robert Ahmed Khan[4], Sim Khairun Nabi Khan[5], A.S.M. Sarwar[6]

[1]Department of Neurosurgery, Holy Family Red Crescent Medical College, Dhaka, [2]Topbright (Pvt.) Ltd, Lalmatia, Dhaka, [3]Department of Pharmaceutical Sciences, Chuina Three Georges University, Hubai, China, [4]Department of Neurosurgery, BSMMU, Shahbag, Dhaka, [5]Department of Neurosurgery, BSMMU, Shahbag, Dhaka, [6]Topbright (Pvt.) Ltd., Lalmatia, Dhaka-1207.

Abstract

Background: Degeneration is a progressive phenomenon in lumbar spinal stenosis patients. The outcome of surgery predictors is sometimes biased. Fusion and stabilization in such cases are unnecessary in many situations. There is still a debate to decompress only versus fusion in low-grade listhesis. Fusion and stabilization in the aged lumbar spine should have clear indications.

Objective: To assess whether the fusion is necessary in lumbar spinal stenosis in selected cases or not and to create a new scoring system among the patients of low backache in Bangladeshi people.

Method: A total of 120 cases were observed retrospectively from 2012 to 2018 in Comfort Hospital, Dhaka, Bangladesh. And 40 more cases data will be collected in the upcoming study period of 6 months. To assess the study we will conduct a survey. In previous cases, the patients had undergone three types of surgeries (Laminectomy, Unilateral approach, and Fusion surgeries). ODI and Swiss score were used for assessment of functional outcome. A new scoring system has been made for patients who may be benefited from fusion or non- fusion surgeries.

Results: In retrospective data, there were 80 male and 40 female patients. Maximum patients were between 41 to 50 years. 59.17% were heavy workers and 66.67% were smoker. Maximum patients (59.17%) had undergone unilateral surgical approaches and 18.33% undergone fusion surgeries. 98.33% patients had satisfactory outcome in our study. In our hybrid scale, the pain status showed, 52.50% had moderate pain, 22.50% had mild pain, 20% had severe pain and only 5% had very severe pain. Maximum participants having low back pain were below 30 years old and 65% lift weight more than 25 kg. The total pain score was significant in our correlation test. The Cronbach's Alpha (.784) was significant in Bangladeshi socio- demographic population.

Conclusion: The outcome of such a study will help to know either fusion surgeries in selected cases are effective for lumbar spinal stenosis or not. Also, it will probably help to select patients for such a study and to improve surgical treatment methods.

Keywords: Spinal Fusion, Lumbar Spinal Stenosis, Scoring system

Introduction

Lumbar stenosis occurs when the central canal, lateral recess, or neural foramen involve compression of the neural elements and their nutrient supply. In the general population, the incidence of lumbar spinal stenosis, which is expected to rise as demographics change, is estimated to be between 1.7% and 8%.

Lumbar stenosis that develops in a congenitally narrow canal is called constitutional stenosis and may occur as early as the third decade of life. Most commonly stenosis arises from degenerative changes in the setting of a spinal canal that was previously normal. The latest gold standard treatment for uncomplicated lumbar spinal stenosis is laminectomy with or without lateral recess and foraminal decompression of the neural components. Severe lumbar stenosis has other spinal deformities, such as spondylolisthesis, scoliosis, or lumbar kyphosis, also. These lesions can be caused by idiopathic, degenerative, or surgery

*Correspondence: *Md. Moshiur Rahman, Department of Neurosurgery, Holy Family Red Crescent Medical College, Dhaka.*
Email: dr.tutul@yahoo.com
ORCID ID: 0000-0002-1183-6829

and can make a presentation and surgical treatment of lumbar spinal stenosis difficult.

Stenosis is the most common symptom of spine surgery in older adults, which will likely increase its prevalence. In recent decades, spinal stenosis surgery has been the fastest-growing form of lumbar spine surgery.[1,2] The overall rate of surgery has leveled off in recent years, but complex lumbar fusions have risen 15 times over six years.[3] It is difficult to treat older adults with spinal stenosis, for many reasons. Unfortunately, the surgical decision making for patients with spinal stenosis continues to have a large range. Surveys among surgeons using structured patient scenarios indicate major differences in decision-making about whether to operate, fuse, and use instrumentation.[4] Other studies indicate that surgeon preferences in the choice of procedures can overshadow patient and disease characteristics.[5] Since serious medical complications, wound complications, mortality, and costs are significantly greater than for decompression alone, the decision to conduct a fusion, and particularly a complex fusion, has important implications.[6,7]

The treatment of spinal stenosis by surgery is greatly different from the treatment of uncomplicated stenosis. In addition to neural decompression, clinical results are improved by pursuing fusion in cases of complex stenosis, usually in combination with instrumentation placements. Instrumentation-augmented fusion helps to minimize and stabilize deformity, as well as preserve or restore coronal and sagittal equilibrium. With a suitable set of techniques for the deformity of each patient, a surgeon can significantly enhance pain, quality of life, functional capability, and cosmesis. The decision to perform surgery includes balancing risk factors such as age, comorbidity, and preoperative functional disability against potential benefits of enhanced neurological function, reduced discomfort, and reduced risk of disease progression. A comprehensive understanding of these concepts is necessary if complicated lumbar stenosis is to be handled appropriately. Thus, our study aims to assess whether the fusion is necessary in lumbar spinal stenosis in selected cases or not and to create a new scoring system among the patients of low backache in Bangladeshi people.

Materials and Methods

This was a mixed method having retrospective data with some prospective data. A total of 120 cases were observed retrospectively from 2012 to 2018 in Comfort Hospital, Dhaka, Bangladesh. And 40 more cases data were collected in the upcoming study period. The study place was Comfort Hospital, Dhaka, Bangladesh. The time period of the study was 6 months from the date of approval. As per the inclusion and exclusion criteria of degenerated lumbar spinal stenosis and low back pain, samples were taken. A total of 160 samples was enrolled in this research.

Subjects were selected conveniently according to inclusion and exclusion criteria and availability of cases. In our study, we developed a hybrid scoring system in the perspective of Bangladeshi socio-demographic condition following ODI and SWISS score among our prospective 40 patient's data and measured the pain status of the patients. A detailed history and clinical information were obtained by performing a structured questionnaire which was made in accordance with the questionnaires of ODI and SWISS scale questionnaires. Oral and written consent was taken from all subjects before data collection and the study subjects were requested to complete the provided questionnaires. The authors described the purpose and process of the survey to the people, gave instructions for completing the questionnaire, and emphasized the confidentiality and anonymity of the responses. The questionnaires were completed and collected under the supervision of the authors. We evaluated the significance level of the total pain score relative to the five variables of our hybrid scoring system.

After obtaining informed written consent this study was conducted among the patients. The purpose and procedure of the study was discussed and informed written consent was obtained from those who agree to participate in the study. Detailed socio-demographic information and clinical history will be recorded by the survey.

Collected data of both samples and controls were edited during and after collection, coded, classified, tabulated, and checked further for any missing information. The data were analyzed using MS Excel spread sheet 2013, Statistical Package for the Social Sciences (SPSS) Version. The results of the study were presented in tables, figures and diagrams. The descriptive statistics of the studs were presented in tables, figures, or suitable graphs, mean ± SD as per the requirement of qualitative and quantitative variables. A p-value of <0.05 was used to establish statistical

significance. The reliability and validity tests using SPSS were done to find the significance level of the total pain score relative to the five variables of our hybrid scoring system.

Results

In the 120 retrospective samples, the mean age of the patients were 50.47±7.53 years. Most of the patients (48.3%) were between 41 to 50 years and a few people (1.7%) were 70+ years (Figure 1). Among these respondents, 80 patients were male whereas one-third (40) were female in this study. Besides, we also observed these 120 patients according to their job criteria and smoking habit. Furthermore, we examined their satisfactory and unsatisfactory outcomes including the types of surgery.

Retrospective data outcomes (n=120)

Figure 1 shows the age and gender distribution among all of the patients (n=120) of this study. Number of male patients were 80 whereas female patients (40) were half in this study. Here, maximum number of patients were between 41 to 50 years old and minimum

number of patients were more than 70 years old. See the figure below-

After that, we developed a hybrid scoring system using our questionnaire in the perspective of Bangladeshi socio-demographic condition following ODI and SWISS score among our prospective 40 patient's data and measured the pain status of the patients. Moreover, we showed four key risk factors of low back pain by mentioning frequency and percentage rate. Lastly, we evaluated the validity and reliability test to measure the significance level of the total pain score relative to the five variables of our hybrid scoring system.

In the table I, the factors related to the outcome among the patients are shown. Here, maximum patients (59.17%) were heavy worker and minimum patients (40.83%) were sedentary workers. Among all, 66.67% were smoker and others were non-smoker. Maximum patients (59.17%) had undergone unilateral surgical approaches and minimum patients (18.33%) had undergone fusion surgeries. Maximum patients (98.33%) had satisfactory outcome in our study.
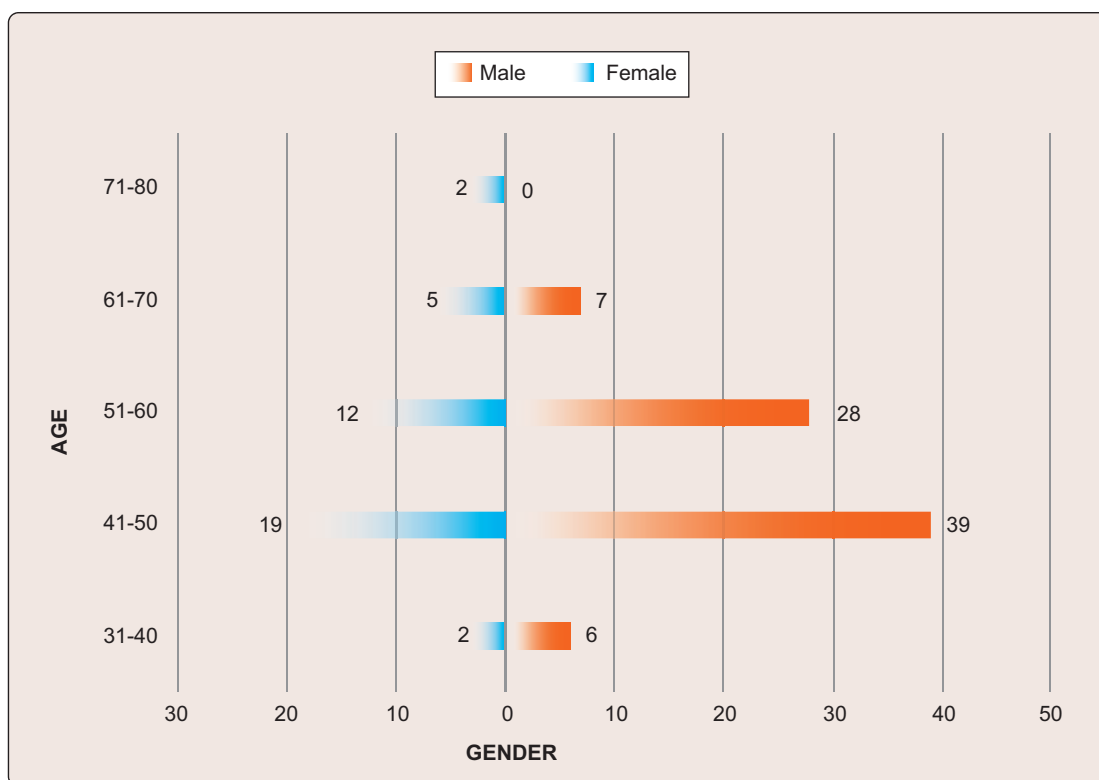

Figure 1: Age distribution of retrospective data by gender (n=120)

Table I: Factors related to the outcome among the patients (n=120)

Factors	Heavy Worker	Sedentary Worker	
Job Criteria	71 (59.17%)	49 (40.83%)	
Smoking	Yes	No	
	80 (66.67%)	40 (33.33%)	
Types of Surgery	Laminectomy	Unilateral	Fusion
	27 (22.50%)	71 (59.17%)	22 (18.33%)
Outcome	None	Satisfactory	Unsatisfactory
	0	118 (98.33%)	2 (1.67%)

Among our prospective 40 patient's data, we developed a hybrid scoring system in Bangladeshi socio-demographic condition in accordance with ODI and SWISS score. We categorized our disability scores in 5 scales that is: normal score (1-5), mild score (6-10), moderate score (11- 15), severe score (16-20), very severe score (21-25). According to this scale, the pain status showed, maximum participants (52.50%) had moderate pain, 22.50% participants had mild pain, 20% participants had severe pain and only 5% participants had very severe pain. See the figure 2.

In the table II, risk factors of low back pain are shown. Here, maximum participants having low back pain were below 30 years old. Maximum participants were male (57.5%) and others (42.5%) were female. Among all, 65% participants lift weight more than 25 kg on regular basis. The factors showed 47.5% participants had sustained sitting and standing followed by 27.5% used to work with back, 20% lift heavy objects and 5% were used to bend frequently in their work fields. See the table II.

Table III shows the validity test by the Pearson correlations (2-tailed). Here, we measured the significance level of the total pain score relative to the
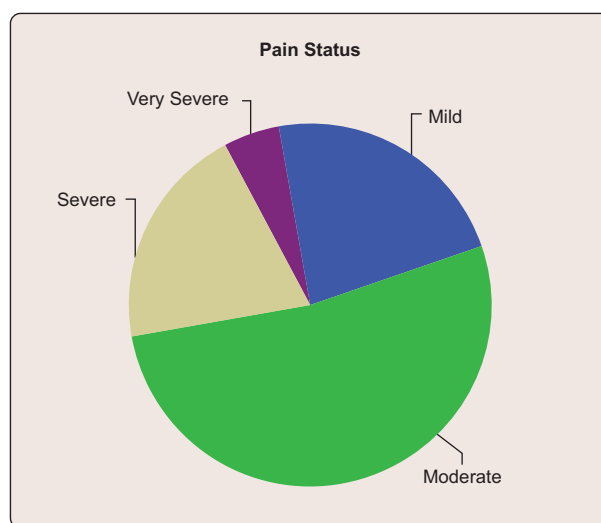

Figure 2: Pain status of the participants of prospective data (n=40)

Table II: Risk factors of low back pain (n = 40)

Variables	Frequency (n)	Percentage (%)
Age		
0<30 years	17	42.5%
30–60 years	20	50%
More than 60 years	3	7.5%
Gender		
Male	23	57.5%
Female	17	42.5%
Weight lifting (>25kg)		
Yes	26	65%
No	14	35%
Physical factors Frequent bending	2	5%
Lifting heavy object	8	20%
Working with back	11	27.5%
Sustained sitting and standing	19	47.5%

Table III: Correlations

		Pain Severity	Intensity Level	Lifting	Walking	Standing	Total SPain
Pain Severity	Pearson Correlation	1	.677**	.068	.209	.010	.479**
	Sig. (2-tailed)		.000	.677	.195	.952	.002
	N	40	40	40	40	40	40
Intensity Level	Pearson Correlation	.677**	1	.518**	.285	.335*	.746**
	Sig. (2-tailed)	.000		.001	.075	.035	.000
	N	40	40	40	40	40	40
Lifting	Pearson Correlation	.068	.518**	1	.080	.366*	.668**
	Sig. (2-tailed)	.677	.001		.626	.020	.000
	N	40	40	40	40	40	40
Walking	Pearson Correlation	.209	.285	.080	1	.467**	.517**
	Sig. (2-tailed)	.195	.075	.626		.002	.001
	N	40	40	40	40	40	40
Standing	Pearson Correlation	.010	.335*	.366*	.467**	1	.681**
	Sig. (2-tailed)	.952	.035	.020	.002		.000
	N	40	40	40	40	40	40
Total_SPain	Pearson Correlation	.479**	.746**	.668**	.517**	.681**	1
	Sig. (2-tailed)	.002	.000	.000	.001	.000	
	N	40	40	40	40	40	40

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

five variables of our hybrid scoring system. The total pain score was significant in our correlation test. See the table III. According to the Cronbach's Alpha (.784) of our test, it was significant in Bangladeshi socio-demographic population.

Discussion

Lumbar spinal stenosis is a condition in which the bone or fibrous tissue that makes up the spinal canal is aberrant, resulting in a reduction in the effective volume of the spinal canal, causing the nerve tissue in the canal to be compressed or stimulated, causing dysfunction. Lumbosacral discomfort and intermittent claudication, which is one of the most frequent degenerative spinal illnesses, are the most common symptoms.[8,9]

Traditional conventional treatment approaches, such as laminectomy, hemi-laminectomy, total laminectomy, or minimally invasive surgery, are the most popular surgical plans. The posterolateral interlateral process, posterior interlaminar fusion technology, and intervertebral fusion technology are all examples of fusion technology.[10] The upper and lower vertebrae, as well as the top and middle vertebrae, commonly use posterior pedicle screws to

decompress and stabilize the narrow segment. Other important advancements or major new research about the efficacy of spinal fusion for degenerative discs that could explain this acceleration are not known to us. Fritzell et al's significant clinical trial, which suggested at least a short-term advantage of fusion over nonsurgical therapy for degenerative discs, had not previously been published.[11] Back surgery rates are more varied than many other types of surgery, and spine fusion rates are more variable than spine surgery rates in general, according to data on geographic variances in medical treatment rates.[12]

We looked at patients between the ages of 41 and 50 in our research. This study demonstrates that surgery rates are rising far faster in the elderly population than in younger persons, with spinal stenosis accounting for the majority of the rise. Back surgery rates were previously shown to be rising fastest in the oldest parts of the population, and for spinal stenosis in particular.[12] Our findings show that surgical risks rise with age, even among persons beyond the age of 60. These risks are far higher than those found in younger patients, who are more likely to have ruptured disc surgery.

Several variables could be at play in this fast rising rate. The majority of patients in our study (59.17 percent) were heavy laborers, while the minority (40.83 percent) were sedentary employees. Sixty-six percent were smokers, while the rest were non-smokers. Risk factors for low back pain showed that the majority of participants (57.5%) were male and the rest (42.5%) were female in the prospective group. Sixty-five percent of the participants regularly lift weights greater than 25 kilograms. The data revealed that 47.5 percent of participants sat and stood for long periods of time, 27.5 percent worked with their backs, 20 percent lifted heavy goods, and 5% bent regularly in their jobs. In our research, the majority of patients (98.33 percent) had a positive outcome. During a 3- to 6-year follow-up period, Katz et al. discovered that 17% of patients in their clinical series required reoperations. The causes for the increase in reoperations are unknown, but plausible explanations include a lower reoperation threshold based on perceived safety; failure of implanted arthrodesis devices, which may be in widespread usage; changes in patient expectations; or a more aggressive surgical philosophy.

Because the number of day laborers is larger in developing nations like Bangladesh, low back pain is a serious problem. It will be highly useful to develop a single scoring system to measure this in our socio-demographic condition. The Cronbach's Alpha (.784) of our hybrid scoring system for low back pain was substantial in the Bangladeshi socio-demographic group, according to the reliability test results. The pattern of ODI score measurements was compared to it. Internal consistency of the ODI is high (Cronbach's 0.71–0.87).[13]

As the population continues to age, more resources will be committed to fusion operations. Because of the wide geographic variations and high complication rate from other surgical procedures, more information about the relative efficacy of fusion surgeries for this condition, as well as the risks and benefits of surgery for specific clinical and demographic subgroups, and more information about individual patient preferences regarding surgical risks and possible outcomes, is needed.

Conclusion

Patients seeking spinal stenosis surgery should be aware of the hazards, and doctors should be aware of the extent of the risks compared to back surgery. The huge rise in fusion surgery rates shows that the indications for fusion and the efficacy of fusion for diverse degenerative disorders need to be better defined. We expect that this new scoring method will be useful to Bangladeshi people, and the results of the study will assist determine if fusion procedures are helpful for lumbar spinal stenosis in specific cases. We hope that our research may inspire more research in this area in the future.

References

1. Taylor VM, Deyo RA, Cherkin DC, Kreuter W. Low back pain hospitalization: recent United States trends and regional variations. *Spine* 1994; 19:1207–13.
DOI: 10.1097/00007632-199405310-00002

2. Deyo RA, Gray DT, Kreuter W, Mirza S, Martin B. United States trends in lumbar fusion surgery for degenerative conditions. *Spine* 2005; 30:1441–45.
DOI: 10.1097/01.brs.0000166503.37969.8a

3. Deyo RA, Mirza SK, Martin BI, Kreuter W, David C.G, Jeffrey G.J. Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. JAMA 2010; 303:1259–65.
DOI: 10.1001/jama.2010.338

4. Irwin ZN, Hilibrand A, Gustavel M, McLain R, Shaffer W, Myers M, et al. Variation in surgical decision making for degenerative spinal disorders. Part I: lumbar spine. *Spine* 2005; 30:2208–13.
DOI: 10.1097/01.brs.0000181057.60012.08

5. Katz JN, Lipson SJ, Lew RA, Grobler LJ, Weinstein JN DO, Brick GW et al. Lumbar laminectomy alone or with instrumented or noninstrumented arthrodesis in degenerative lumbar spinal stenosis. Patient selection, costs, and surgical outcomes. *Spine* 1997; 22:1123–31.
Available From: journals.lww.com/spinejournal/abstract/1997/05150/lumbar_laminectomy_ alone_or_with_ instrumented_or.12.aspx

6.   Deyo RA, Ciol MA, Cherkin DC, Loeser JD, Bigos SJ. Lumbar spinal fusion: a cohort study of complications, reoperations, and resource use in the Medicare population. *Spine* 1993; 18:1463–70.
Available From: journals.lww.com/spinejournal/abstract/1993/09010/lumbar_spinal_fusion __a_cohort_study_of.10.aspx

7.   Ciol MA, Deyo RA, Howell E, Kreif S. An assessment of surgery for spinal stenosis: time trends, geographic variations, complications, and reoperations. *J Am Geriatr Soc* 1996; 44:285–90.
DOI: 10.1111/j.1532-5415.1996.tb00915.x

8.   Ong KL, Auerbach JD, Lau E, Schmier J, Ochoa JA. Perioperative outcomes, complications, and costs associated with lumbar spinal fusion in older patients with spinal stenosis and spondylolisthesis. *Neurosurg Focus*. 2014;36:E5.
DOI: 10.3171/2014.4.FOCUS1440

9.   Guangtao S, Jiaxue W, Yaohui C. Posterior lumbar laminectomy and intervertebral fusion in treatment of lumbar spinal stenosis in 16 cases. Henan J Surg 2014, 18-19.
Available From: caod.oriprobe.com/articles/43596595/ Posterior_ lumbar_laminectomy_and_intervertebral_ fusion_in_treatment_of.htm

10. Alexander N, Lindsay MA, Mark DK, David LS. Bilateral congenital posterior hemivertebrae and lumbar spinal stenosis treated with posterior spinal fusion and instrumentation. *JAAOS: Global Research and Reviews* 3:p e19.00054, 2019.
DOI: 10.5435/JAAOSGlobal-D-19-00054

11. Fritzell P, Hagg O, Wessberg P, Nordwall A. Volvo award winner in clinical studies: lumbar fusion versus nonsurgical treatment for chronic low back pain: a multicenter randomized controlled trial from the Swedish Lumbar Spine Study Group. *Spine* 2001;26:2521–32.
DOI: 10.1097/00007632-200112010-00002

12. The Center for the Evaluative Clinical Sciences and The Center for Outcomes Research and Evaluation. Dart- mouth Atlas of Musculoskeletal Health Care. *Chicago, IL: American Hos- pital Association*, 2000.
PMID: 36630545

13. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine (Phila Pa 1976) 2000;25:2940 –52.
DOI: 10.1097/00007632-200011150-00017.