



Cost-effectiveness of different treatment modalities of lumbar spondylolisthesis

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Abstract



Lumbar spondylolisthesis displaces one lumbar vertebra over another and often causes nerve root pressure and various symptoms, including low back pain, numbness, tingling, discomfort, stiffness, and muscular tightness. The lumbar region of the spine comprises five vertebrae (L1-L5) and S1, intervertebral discs, facet joints, pars interarticularis, foramina, spinal canal, discs, transverse process, and muscles. So, understanding the spine's structure is crucial for figuring out what is causing the issue. Lumbar spondylolisthesis can result from a variety of circumstances. Its complex etiology includes inflammatory joint illnesses, repeated stress, hereditary susceptibility, fractures, wear and tear, and abnormalities in the pars interarticularis. Lumbar Spondylolisthesis is the most prominent condition in the Department of Neurosurgery and Orthopedics. Conducted a prospective observational study of patients (n=200) diagnosed with Lumbar spondylolisthesis. The data was gathered and examined using the Oswestry Disability Index (ODI) score. Various diagnostic tests were performed to confirm SPL. Surgical treatment, Conservative Management, and physiotherapy were used in the treatment. Finally, the cost of surgical and conservative therapy was estimated to determine Lumbar Spondylolisthesis's cost-effectiveness. Of 200 patients, 118 were treated with Conservative Management, and 82 had Surgical Management. Conservative management is considered less cost-effective, at 16.58% of the total expenditure, whereas surgical management constitutes 83.42% of the total spending and is deemed more cost-effective. Therefore, a study needs to create awareness and provide knowledge about the costs and cost-effectiveness of various lumbar spondylolisthesis treatment choices.

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INTRODUCTION

Lumbar spondylolisthesis displaces one lumbar vertebra over another, which frequently causes nerve root pressure and various symptoms, including low back pain, numbness, tingling, discomfort, stiffness, and muscular tightness [1]. The lumbar region of the spine consists of five vertebrae (L1-L5) and S1, intervertebral discs, facet joints, pars interarticularis, foramina, spinal canal, discs, transverse process, and muscles. So,

understanding the spine's structure is crucial for figuring out what is causing the issue. Lumbar spondylolisthesis can result from a variety of circumstances [2]. SPL's complex etiology includes inflammatory joint illnesses, repeated stress, hereditary susceptibility, fractures, wear and tear, and abnormalities in the pars interarticularis [3].

Lumbar Spondylolisthesis is the most prominent condition in the Department of Neurosurgery and Orthopedics. Most patients were hospitalized with primary symptoms of low back pain, numbness, tingling, discomfort, and muscular tightness. Some patients were admitted owing to injury, trauma, an accident, or a fall from a two-wheeler vehicle [4]. The data was gathered and examined using the Oswestry Disability Index (ODI) score. In Neurosurgery, laboratory examinations such as CBC, X-ray, CT scan, MRI, and bone scan were employed, as well as electromyography, myelogram, and flexion and extension X-rays to confirm SPL [5]. Surgical procedures included laminectomy, discectomy, spinal fusion, canal stenosis, discectomy with implants, transforaminal block, and laminectomy with discectomy. The cost of the surgeries is as follows ₹25,000, ₹25,000, ₹50,000, ₹20,000, ₹50,000, ₹30,000, ₹50,000. In Conservative Management, antacids, NSAIDs, analgesics, corticosteroid injections, muscle relaxants, neuropathic drugs, braces, and physiotherapy were used in treating SPL [6]. Different medications were prescribed for each class of drugs. The cost of therapy, surgery, and hospital stay were calculated. Finally, the cost of surgical and conservative treatment was estimated to determine the cost-effectiveness of Lumbar Spondylolisthesis [7].

MATERIALS AND METHODS:

Place of the study: The study "Cost-effective analysis of different treatment modalities for lumbar spondylolisthesis" was performed in the Department of Neurosurgery and Orthopaedic in Narayana Hospitals, which is a 1600 bedded multidisciplinary hospital, under the guidance of P. Sasikala, Assistant professor, Department of Pharmacy Practice, Narayana Pharmacy college.

Study Design: The study design was a single-centered, prospective observational study conducted in a territory care hospital's Neurosurgery and Orthopedic departments [8].

Study site: The study was conducted at Narayana Medical College and Hospital.

Study Population: Approximately 200 patients suffering from lumbar spondylolisthesis and different treatment modalities were enrolled in the study [9].

Study Duration: This study was conducted for 6 months (September 2023-February 2024).

Study Criteria: The patients were enrolled based on inclusion and exclusion criteria [10].

Inclusion criteria:

Patients of both genders.

Patients of age over 18 years [11].

The patients who were diagnosed with lumbar spondylolisthesis and who underwent different treatment options like conservative and surgery [12].

Exclusion criteria:

Pregnancy women.

Pediatrics.

Patients of age less than 18 years [13].

Study materials:

Patient informed consent form [14].

A specially designed patient data collection proforma.

Oswestry Disability Index (ODI) [15].

Patient medical records.

Ethical approval

Study method:

The patients are enrolled in this study after getting informed consent from them. The enrollment of patients was done based on inclusion and exclusion criteria. The data for the study was collected by the "Chart Review method," which is well-suited to finding all the necessary baseline information, which was collected on distinctive design patient data collection proforma that includes patient demographics like,

Age

Gender

Marital status

Reasons for Admission

Laboratory Investigations

Surgery Procedures

Class of drugs used.

Physician medication order form

Nurse's medication administration record (Drug chart) and communication data [16].

Study Procedure: A prospective observational study was conducted for six months in the Neurosurgery and Orthopaedic departments [17].

Based on inclusion and exclusion criteria, the patients with lumbar spondylolisthesis who underwent conservative management & different surgical treatments were recruited in the study [18].

The data was collected through personal (patient / patient representative) interviews using a well-structured patient data collection proforma and followed up.

All necessary and relevant baseline information was collected on the patient data collection proforma, which includes [19]:

Patient demographic characteristics such as age, gender, personal history, habits and

socioeconomic status.

Past medication history

Past medical history

Present medication

Risk factors

Statistical Analysis:

All the data was collected, and frequencies, percentages, cost-effective analysis, and ODI score measures were analyzed.

The collected and documented data was analyzed based on the following parameters:

Patient distribution is based on demographic data.

Patient distribution is based on gender.

Patient distribution is based on age.

Patient distribution is based on risk factors.

Based on cost details [20].

RESULTS:

A total of 200 patients were screened. Out of 200, 118 patients were enrolled under Conservative Management, and 82 were enrolled under Surgical Management. Conservative management, with a total cost of 12,400, is 16.58% of the total expenditure and is considered less cost-effective. On the other hand, surgical management, with a total cost of 62,400, constitutes a sizable portion of 83.42% of the total expenditure, and it is considered more cost-effective.

Table 1 shows the demographic details of the patients, such as Age, Gender, Marital status, Reasons for admission, Laboratory tests, Name of the surgeries, Class of drugs, Cost of the treatment, and Outcomes

Factors	Total No. of Patients (N=200)	Total Percentage
AGE		
20-30	16	8.08%
31-40	18	9.09%
41-50	32	16.16%
51-60	56	28.28%
61-70	38	19.19%
71-80	21	10.61%
81-90	17	8.59%
GENDER		
Female	111	55.50%
Male	89	44.50%
MARITAL STATUS		
Married	193	96.50%
Unmarried	7	3.50%
REASONS FOR ADMISSION		
Low back pain	180	35.29%
Numbness	130	25.49%
Tingling	120	23.53%
Tenderness	60	11.76%
Muscle tightness	20	3.92%
LABORATORY TESTS		
X-Rays	180	18.00%
CT-Scan	180	18.00%
MRI	150	15.00%
Bone scan	130	13.00%
Flexion & Extension X-Rays	150	15.00%
Myelogram	10	1.00%
Electromyography	200	20.00%

Table 1 shows the demographic details of the patients, such as Age, Gender, Marital status, Reasons for admission, Laboratory tests, Name of the surgeries, Class of drugs, Cost of the treatment, and Outcomes (continued)

SURGERY PERFORMED		
Laminectomy	36	25.17%
Discectomy	38	26.57%
Spinal fusion	22	15.38%
Transforaminal block	8	5.59%
Canal stenosis	8	5.59%
Laminectomy +Discectomy	26	18.18%
Discectomy + implants	5	3.50%
CLASS OF DRUGS USED		
Antacids	200	24.54%
NSAIDS	180	22.09%
Analgesics	165	20.25%
Corticosteroids	50	6.13%
Muscle relaxants	20	2.45%
Neuropathic pain drugs	200	24.54%
TREATMENT OUTCOMES		
Recovered	147	73.50%
No Recovered	53	26.50%

Table 2 Shows Oswestry disability index score (ODI)

S. No	Odi Score	No. of Patients	Percentage
1	0-20% (Minimally disability)	152	76%
2	21-40% (Moderate disability)	37	18.5%
3	41-60% (Severe disability)	4	2%
4	61-80% (crippled)	2	1%
5	81-100% (Bedbound)	5	2.5%

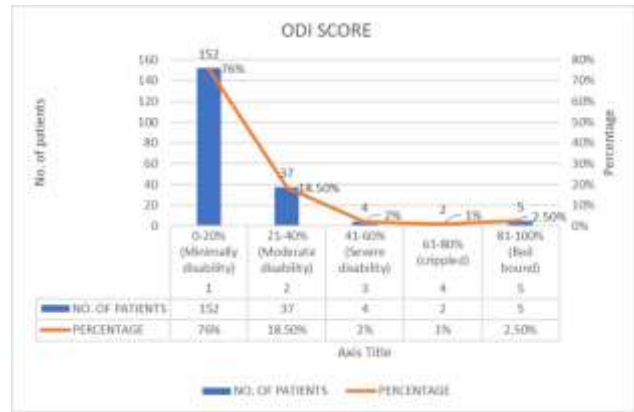


Figure 1 Shows the score of disability of SPL patients



Figure 2 Shows the percentage of Cost-effectiveness of Conservative and Surgical Management

DISCUSSION:

In our study, we estimated the Cost-effective analysis of different treatment modalities of lumbar spondylolisthesis. We considered 200 patients in our sample population. Among those age group patients, 51 – 60 (n=56; 28.28%) suffer from SPL, and 20 – 30 (n=16; 8.08%) suffer less from SPL. The data presented compares conservative and surgical management for several factors. In terms of age groups, surgical management seems more prevalent in older patients, while conservative management is more common in the younger population. Based on gender distribution among patients undergoing conservative and surgical management. In both

Table 3 Shows the cost-effectiveness of Surgical and Conservative treatments

S. No	Different Treatments	Total Cost (10 Days)	Percentage	Cost-Effectiveness
1	Conservative Management	12,400	16.58%	Less cost-effect
2	Surgical Management	62400	83.42%	High-cost effect

genders, the majority receive conservative and surgical management, with 55.50% of females and 44.50% of males. Interestingly, the percentage of females undergoing surgical management is slightly higher (59.32%) than males (40.68%). Among the patients, married individuals make up 96.50%, while unmarried individuals make up only 3.50%.

Low back pain is the predominant reason for admission, with 35.29% of patients citing it as their primary concern. Numbness and tingling follow closely, constituting 25.49% and 23.53% of admissions, respectively. Tenderness and muscle tightness represent 11.76% and 3.92%, respectively.

X-rays and CT - Scans are the most employed, each constituting 18.00% of the tests performed. MRI follows closely at 15.00%, highlighting the importance of advanced imaging techniques. Bone scans and flexion and extension X-rays account for 13.00% and 15.00%, respectively. Electromyography (EMG) is conducted on all patients, making up 20.00% of the tests. The low use of myelogram (1.00%) may imply a limited role or specific indications for this invasive procedure within the studied population.

Among the total patient population, the distribution of different spinal surgeries is as follows: Discectomy and laminectomy are the most prevalent, with percentages of 26.57% and 25.17%, respectively, highlighting their prominence in surgical interventions. Spinal fusion and combined procedures such as laminectomy + discectomy and discectomy + implants make up 15.38%, 18.18%, and 3.50%, respectively. Transforaminal block and canal stenosis surgeries account for 5.59%, respectively.

Antacids and neuropathic pain drugs are the most prescribed, each being 24.54% of medication is used. NSAIDs and Analgesics contribute 22.09% and 20.25%, respectively. Corticosteroids, prescribed to 6.13% of patients, may show a targeted use for specific inflammatory conditions or exacerbations, given their potent anti-inflammatory effects. Muscle relaxants were prescribed to 2.45% of patients.

A variety of drugs were prescribed for managing SPL; pantop-40 (10.08%), Gabapin (10.79%) and Preganix-M (12.01%) are the most prescribed

drugs. Among other medications, Hifenac MR (9.12%), Voveran AQ (4.56%), Ultralise (7.71%), Lupiritin (9.76%), Decadron (5.14%) and Nervigen -NP (12.20%) respectively.

Laminectomy and discectomy are the most common surgeries, with 25.17% and 26.57%, respectively, both incurring a cost of 25000. Although less familiar with 22 cases, spinal fusion incurs a higher cost of 50000. Transforaminal block and canal stenosis surgeries, each with eight instances, cost 30,000 and 20,000, respectively. Combined procedures like laminectomy + discectomy and discectomy + implants, each involving 26 and 5 cases, consistent cost of 50,000, respectively.

The treatment outcomes are positive, with 73.50% of patients reporting recovery. However, 26.50% of patients have not recovered due to the nature of spinal conditions, comorbidities, and treatment compliance.

Based on disability percentage or ODI score, most patients (76%) fall into the 0-20% range, indicating minimal disability. However, it's concerning that a small percentage have severe disabilities.

Conservative management, with a total cost of 12,400, is 16.58% of the total expenditure and is deemed less cost-effective. On the other hand, surgical management, with a total cost of 62,400, constitutes a significant portion of 83.42% of the total expenditure. It is considered highly cost-effective.

CONCLUSION:

Our study shows the cost-effective assessment of alternative treatment options for lumbar spondylolisthesis, including 200 patients, reveals the following main findings: Surgical therapy tends to be more common in older individuals, whereas conservative care is popular in the younger group. The gender breakdown reveals a slightly larger percentage of females receiving procedures performed. The most common reason for admission is low back pain, followed by numbness and tingling. Advanced imaging techniques, such as X-rays and CT scans, are widely used, emphasizing the need for exact diagnosis. Discectomy and laminectomy emerge as the most common spinal operations, with positive results recorded in 73.50% of patients.

Antacids and neuropathic pain medicines are the most regularly given medications, with Pantop-40, Gabapin, and Preganix-M being particularly popular. Most patients had minimal disability (0-20%), forming 76% of cases. The presence of patients with moderate to severe disabilities (21-100%) emphasizes the need for targeted interventions and support systems for individuals with higher ODI scores. Spinal fusion surgery costs \$50,000 more than laminectomy and discectomy procedures, which cost \$25,000. Even if cautious care is less economical, surgical operations account for a significant amount (83.42%) of overall costs. The favorable treatment outcomes (73.50% recovery rate) underscore the effectiveness of the chosen interventions. However, due to the nature of their spinal conditions, comorbidities, and compliance with treatment, a significant portion of patients (26.50%) did not make a full recovery. Therefore, there is a need for a study to create awareness and provide knowledge about the costs and cost-effectiveness of various lumbar spondylolisthesis treatment choices.

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Author Contribution

All authors made substantial contributions to the conception, design, acquisition, analysis, or interpretation of data for the work. They were involved in drafting the manuscript or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring its accuracy and integrity.

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