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Research Article

Cost-Effectiveness Of Different Treatment Modalities Of Lumbar Spondylolisthesis

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Abstract

Background: Lumbar spondylolisthesis is defined as the displacement of one lumbar vertebra over another, which 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. SPL's complex aetiology includes inflammatory joint illnesses, repeated stress, hereditary susceptibility, fractures, wear and tear, and abnormalities in the pars interarticularis.

Methodology: Lumbar Spondylolisthesis is the most prominent condition seen in the Department of Neurosurgery and Orthopedics. We 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 included 7 types of surgeries. In Conservative Management, antacids, NSAIDs, analgesics, corticosteroid injections, muscle relaxants, neuropathic drugs, braces, and physiotherapy were used to treat SPL. Finally, the cost of surgical and conservative therapy was estimated to find the cost-effectiveness of Lumbar Spondylolisthesis.

Results: Out of 200 patients, 118 were treated with Conservative Management and 82 had Surgical Management. Conservative management is considered less cost-effective, being 16.58% of the total expenditure. Contrarily, surgical management, which constitutes a sizable part of 83.42% of the total expenditure, is deemed more cost-effective.

Conclusion: Therefore, there is a need for study to create awareness and provide knowledge about the costs and cost-effectiveness of various lumbar spondylolisthesis treatment choices.

Key Words: Lumbar Spondylolisthesis, Cost-effectiveness, Surgical management, Conservative management, Laminectomy, Discectomy.

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Introduction

Lumbar spondylolisthesis is defined as the displacement of one lumbar vertebra over another, which frequently causes nerve root pressure and a variety of symptoms including low back pain, numbness, tingling, discomfort, stiffness, and muscular tightness^[1, 2]. The lumbar region of the spine consists of five vertebrae (L1-L5) and S1, as well as intervertebral discs, facet joints, pars interarticularis, foramina, spinal canal, discs, transverse process, and muscles. So, understanding the structure of the spine is crucial for figuring out what is causing the issue.^[3, 5, 6] Lumbar spondylolisthesis can result from a variety of circumstances. SPL's complex aetiology includes inflammatory joint illnesses, repeated stress, hereditary susceptibility, fractures, wear and tear, and abnormalities in the pars interarticularis^[7, 9].

Lumbar Spondylolisthesis is the most prominent condition seen in the Department of Neurosurgery and Orthopedics.^[8, 9, 10] A majority of the patients were hospitalized with primary symptoms of low back pain, numbness, tingling, discomfort, and muscular tightness.^[11, 12] Some patients were admitted owing to injury, trauma, an accident, or a fall from a two-wheeler vehicle. The data was gathered and examined by using the Oswestry Disability Index (ODI) score.^[13, 14] 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. Surgical procedures included laminectomy, discectomy, spinal fusion, canal stenosis, discectomy with implants, transforaminal block, and laminectomy with discectomy.^[15, 16] 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. Different medications were prescribed for each class of drugs.^[17, 18, 24] The cost of therapy, surgery, and hospital stay were calculated. Finally, the cost of surgical and conservative therapy was estimated to determine the cost-effectiveness of Lumbar Spondylolisthesis.^[32]

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 Hospitals.

Study Design: The study design was a single-centered, prospective observational study conducted in the Neurosurgery and Orthopedic departments of a territory care hospital.

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

Study Duration: This study was conducted for 1 year (September 2023-September 2024).

Study Criteria: The patients were enrolled in the study based on inclusion and exclusion criteria.

Inclusion criteria:

- Patients of both genders.
- Patients of age over 18 years.
- The patients who were diagnosed with lumbar spondylolisthesis and who underwent different treatment options like conservative and surgery.

Exclusion criteria:

- Pregnancy women.
- Pediatrics.
- Patients of age less than 18 years.

Study materials:

- Patient informed consent form.
- A specially designed patient data collection proforma.
- Oswestry Disability Index (ODI)
- 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 find 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.

Study Procedure: A prospective observational study was conducted for six months of duration in the Neurosurgery and Orthopaedic departments.

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

The data was collected through personal (patient / patient representative) interviews, by 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:

1. Patient demographics characteristics such as age, gender, personal history, habits and socioeconomic status.
2. Past medication history
3. Past medical history

- 4. Present medication
- 5. Risk factors

- 2. Patient distribution based on risk factors.
- 3. Based on cost details

Statistical Analysis:

All the data was collected, and analysis was performed by frequencies, percentages, cost-effective analysis, and measures of ODI score.

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

- 1. Patient distribution based on demographic data.
 - Patient distribution is based on gender.
 - Patient distribution is based on age.

Results

A total of 200 patients were screened. Out of 200, 118 patients were enrolled under Conservative Management and 82 patients were enrolled under Surgical Management. Conservative management, with a total cost of 12,400, stands for 16.58% of the total expenditure and it 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.

1.1 Figures

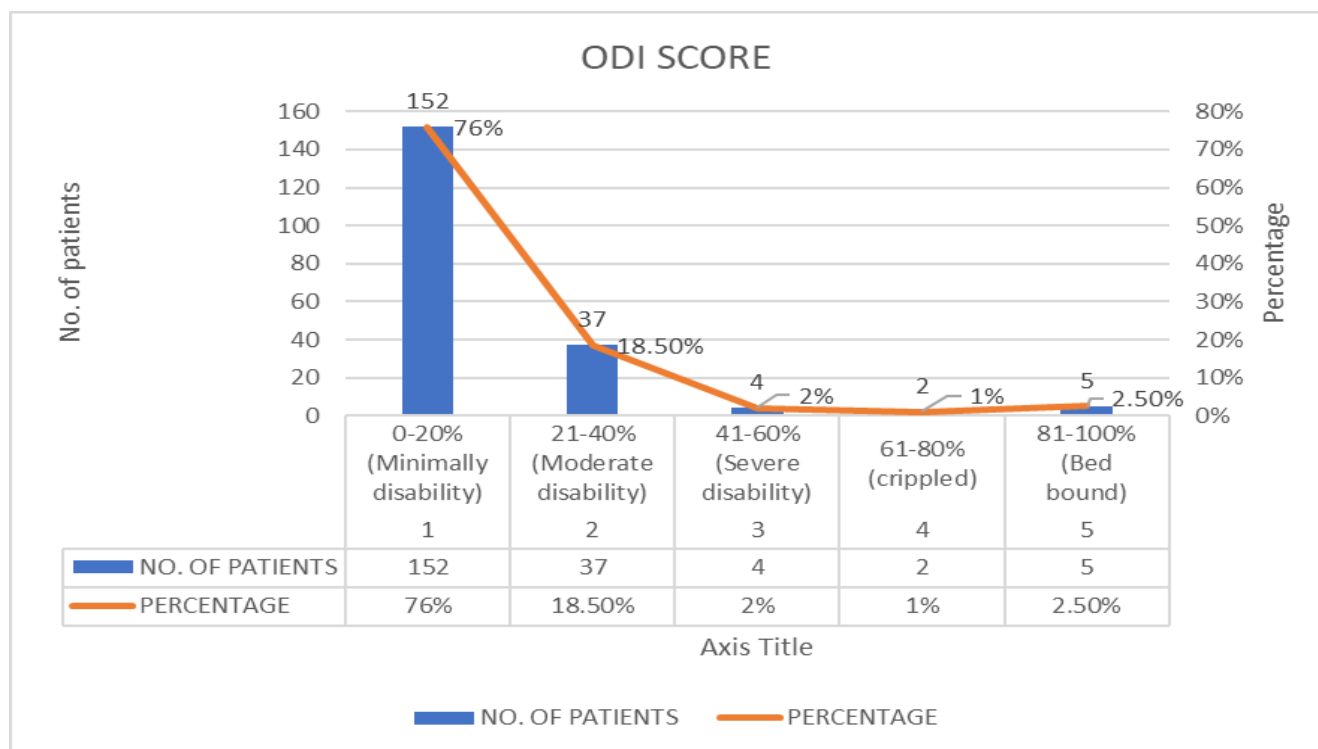


Fig. 1. Shows the score of disability of SPL patients.

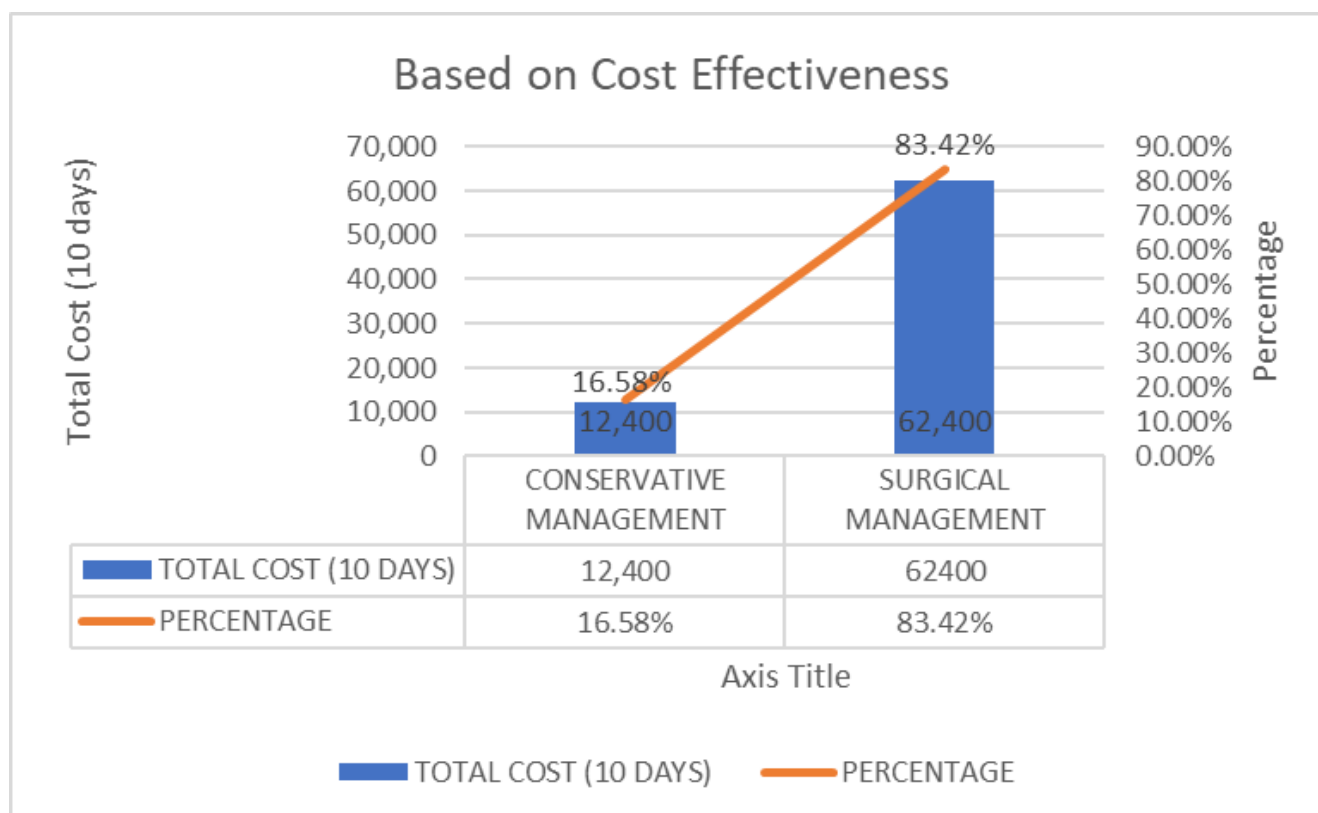


Fig. 2. Shows the percentage of Cost-effectiveness of Conservative and Surgical Management

1.1 Tables

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)	OF 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%

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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%
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%

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

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 patients of Age groups, 51 – 60 (n=56; 28.28%) are suffering from SPL and 20 – 30 (n=16; 8.08%) are less suffering from SPL. The data presented

shows a comparison between 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 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%) compared to 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: **Davison MA et. al** Discectomy and laminectomy are the most prevalent, with percentages of 26.57% and 25.17% respectively, highlighting their prominence in the surgical interventions. Spinal fusion and combined procedures such as laminectomy + discectomy and discectomy + implants make up 15.38%, 18.18% and 3.50%, respectively. Notably, transforaminal block and canal stenosis surgeries each 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 **Passias PG et. Al explained**

Laminectomy and discectomy are the most common surgeries, with 25.17% and 26.57% respectively, both incurring a cost of 25000. Spinal fusion, although less common with 22 cases, incurs a higher cost of 50000.

Kepler CK, et. Al explained. Transforaminal block and canal stenosis surgeries, each with 8 cases, have different associated costs of 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 show a positive trend with 73.50% of patients reported as recovered. However, 26.50% of patients have not recovered due to the nature of

spinal conditions, comorbidities, and treatment compliance.

Reitman CA et. Al 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, stands for 16.58% of the total expenditure and it 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. A majority of 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 is more expensive, costing \$50,000, than laminectomy and discectomy procedures, which cost \$25,000. Even if cautious care is less economical, surgical operations account for a large amount (83.42%) of overall costs. The positive 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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