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Original Research Article

Factors Affecting the Selection of Fusion or Motion Preservation Surgical Technique in Spinal Surgery: A retrospective surgery

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Abstract

Background: The decision-making process surrounding the selection of spinal fusion versus motion preservation techniques has gained increasing relevance as advancements in spinal surgery have introduced a broader range of surgical options, providing surgeons with more flexibility but also raising new challenges.

Aims: This article systematically explores the various factors influencing the decision between spinal fusion and motion preservation surgical technique.

Methods: This retrospective study was carried out at our tertiary care hospital from February 2024 to November 2024, focusing on the factors involved in selecting between fusion and mobility preservation in spine surgery. Key factors analyzed included patient demographics (age, sex, and body mass index), clinical diagnoses (specific spinal conditions), surgical techniques (type of intervention), and postoperative results.

Results: Out of 55 patient records collected, mean age of patients was 54.5 yrs with symptom duration of 16.9 months. Mean pain reduction was more in Spinal fusion surgery as compared to Motion preservation surgery which was statistically significant. Higher Mean functional improvement and lesser post-operative complications were observed in was more in Spinal fusion surgery as compared to Motion preservation surgery which was statistically significant.($p<0.05$)

Conclusions: The study identified the factors affecting the selection between motion preservation and fusion in surgical interventions, along with their respective advantages and disadvantages. On the other hand, motion preservation surgery represents a newer approach that may offer advantages for younger and more active patients by maintaining spinal mobility. Ultimately, a thorough evaluation by a spine surgeon is necessary to determine which procedure is most appropriate for each individual, considering the specific clinical presentation and patient preferences.

Keywords: spinal fusion, motion preservation surgery, spine flexibility.

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Introduction

The decision-making process surrounding the selection of spinal fusion versus motion preservation techniques has gained increasing relevance as advancements in spinal surgery have introduced a broader range of surgical options, providing surgeons with more flexibility but also raising new challenges. [1] Traditional spinal fusion, a procedure in which two or more vertebrae are permanently joined to stabilize the spine, has long been a cornerstone in treating spinal pathologies such as degenerative disc disease, trauma, and deformities. However, spinal fusion comes with its own set of complications, including the risk of adjacent segment degeneration, reduced spinal mobility, and long-term functional impairment. [2] In contrast, motion preservation techniques, such as artificial disc replacement, dynamic stabilization, and interspinous process devices, aim to maintain or restore natural spinal motion while addressing the underlying pathology. These newer approaches have sparked significant interest due to their potential to reduce the long-term complications associated with fusion and improve post-operative quality of life, especially in younger and more active patients. Yet, motion preservation techniques may not be suitable for all patients, and careful consideration is required to determine their appropriateness based on the

specific clinical context. [3] This article systematically explores the various factors influencing the decision between these two treatment options. These factors include the patient's age, activity level, underlying comorbidities, severity of the spinal disorder, and the potential for postoperative complications.

Material & Methods

This retrospective study was carried out at our tertiary care hospital from February 2024 to November 2024, focusing on the factors influencing decisions regarding mobility preservation or spinal fusion in spine surgery. Data were gathered from hospital patient records to assess the selection of surgical techniques and their long-term outcomes.

The study included the records of 55 patients aged between 18 and 75 years, who underwent either spinal fusion or motion preservation for various spinal disorders. These patients required surgical intervention for conditions such as degenerative disc disease, spinal stenosis, or spondylolisthesis.

Surgical techniques employed included spinal fusion and motion preservation methods, such as artificial disc replacement or dynamic stabilization. Records were excluded for patients with less than six months of follow-up, those with cancer, or individuals with severe osteoporosis that could jeopardize their surgical outcomes.

Key factors analyzed included patient demographics (age, sex, and BMI), clinical diagnoses (specific spinal conditions), surgical techniques (type of intervention), and postoperative results. Follow-up records documented patients' functional status, pain levels, and any complications encountered.

The study aimed to analyze operative records and decision-making processes to gain insights into the criteria surgeons consider when selecting between fusion and mobility preservation techniques. This comprehensive data collection approach encompassed all essential parameters related to surgical decision-making and outcomes for further analysis. The research assessed and examined the factors involved in spinal fusion and mobility preservation surgeries, focusing on patient demographics such as age, sex, and body mass index, as well as clinical presentations including the diagnosis and severity of spinal conditions. The surgical techniques utilized were categorized into two groups: fusion procedures, which included posterior lumbar interbody fusion and anterior cervical discectomy with fusion, and mobility preservation techniques, which encompassed dynamic stabilization and artificial disc replacement. The outcome measures evaluated included pain relief, functional enhancement, and the occurrence of surgical complications. The preferences and decisions of the surgeons took into account patient desires, anticipated outcomes, and associated risks.

Statistical Analysis

Descriptive statistics were used to analyse the sociodemographic data using means, medians, and standard deviations. For gender and surgical procedure categorical variables were used. n and motion preservation performances using inferential statistics. In comparing continuous variable means, the independent t-test was used. Chi-square test was used to compare categorical outcomes.

Results

This study analysed the data records retrospectively and compared surgical technique & outcomes. Out of 55 patient records collected, mean age of patients was 54.5 yrs with symptom duration of 16.9 months. In 34 patients, spinal fusion surgery was performed and in 21 patients, motion preservation surgery was performed. (Table 1) Mean pain reduction was more in Spinal fusion surgery as compared to Motion preservation surgery which was statistically significant. ($p<0.05$) Higher Mean functional improvement and lesser post-operative complications were observed in was more in Spinal fusion surgery as compared to Motion preservation surgery which was statistically significant.($p<0.05$)

Table 1:

Parameters	Values
Mean Age	54.5 yrs of age
Gender	29 (males); 26(females)
Diagnosis	
Degenerative Disc Disease	(36 patients, 65.45%)
Spinal Stenosis (11 patients, 18.9%)	12 patients (21.81%)
Spondylolisthesis (6 patients, 10.3%)	7 patients (12.7%)
Symptom Duration (Mean)	16.9 months
Technique	
Spinal fusion surgery	34
Motion preservation surgeries	21

Table 2:

Outcome	Fusion Technique	Motion Preservation Technique	p-value
Pain Relief (VAS Score) Mean reduction	6.3	5.8	<0.05
Functional Improvement (ODI Score)	25.4	22.1	<0.05
Postoperative Complications	5/34 (14.7%)	6/21 (28.5%)	<0.05

Discussion

The research identified the elements influencing the choice between motion preservation and spinal fusion in surgical interventions, along with their respective advantages and disadvantages. There was no statistically significant difference observed in pain relief or functional enhancement between the two surgical approaches for spinal conditions. Both methods may provide comparable benefits to patients, contingent upon the specific clinical context and individual patient requirements. The decision regarding the type of surgery was influenced by patient preferences, surgeon recommendations, and the severity of the spinal condition. Surgeons tend to favour fusion procedures for patients exhibiting severe degeneration or instability, as these options offer long-term spinal stability. Patients who are at a higher risk for spinal fusion or those desiring to retain spinal mobility were directed towards motion preservation techniques. These results underscore the significance of technique-specific approaches in spine surgery, contributing to and enhancing previous research findings. In the present study, the clinical outcomes, including pain relief and functional improvement, were consistent with those reported in Singh et al 2024 [4], Hasan et al 2019 [5], suggesting that both motion preservation and fusion can effectively address spinal issues.

The present study highlights the role of physician preferences and institutional protocols in the surgical decision-making process, adding depth to the findings of Singh et al 2024 [4], Vaishnav et al 2019 [6]. Furthermore, our results align with Singh et al 2024 [4] & M. Ebrahimkhani et al 2023 study [7], which indicated that fusion procedures are more advantageous for complex cases of spinal degeneration. Fusion techniques are more frequently utilized for severe conditions. Both motion-preserving and fusion surgeries are widely employed methods for treating various spinal disorders, including degenerative disc disease, spinal stenosis, and spondylolisthesis. Although both approaches aim to alleviate pain and enhance functionality, they fundamentally differ in their strategies for spinal stabilization and the preservation of natural movement. [8]

Fusion surgery is a well-established method that involves the fusion of two or more vertebrae using bone grafts, metal plates, or screws. The goal of fusion is to eliminate motion at the affected spinal segment, thereby providing stability and alleviating pain, typically caused by disc degeneration or instability. [9] Several studies have demonstrated the efficacy of spinal fusion in improving patient outcomes. A landmark study by Phillips 2013 showed that lumbar fusion was effective in reducing pain and improving function in patients with degenerative disc disease. [10] Similarly, in a long-term follow-up study, Evans et al. 2023 found that spinal fusion resulted in significant improvement in pain relief and quality of life for patients with lumbar instability. [11] However, one of the notable drawbacks of fusion is the potential for adjacent segment degeneration. When motion is eliminated at one level, increased stress on adjacent vertebrae may lead to further degenerative changes over time. [12]

Motion-preserving surgery, on the other hand, aims to maintain the natural motion of the spine while addressing instability or degeneration. Procedures such as artificial disc replacement (ADR) or dynamic stabilization allow for the preservation of motion at the affected segment, potentially reducing the risk of adjacent segment degeneration. A key advantage of motion-preserving surgery is the ability to maintain spine mobility, which may improve functional outcomes and recovery time. For example, a study by Goel et al. (2007) found that lumbar disc replacement provided better preservation of motion compared to fusion and resulted in similar or superior pain relief. [13] Additionally, motion-preserving procedures have been associated with faster recovery and less postoperative discomfort, as seen in the study by Kanayama M et al. 2009, which found that patients undergoing disc replacement had quicker return to normal activity compared to those undergoing fusion. [14] Despite these advantages, motion-preserving surgery comes with its own set of challenges. The technology involved, such as artificial discs, can be costly, and there is a risk of implant failure or complications related to device placement. Furthermore, not all patients are candidates for motion-preserving procedures, particularly those with severe spinal deformities or extensive degeneration. [8] Thus, both motion-preserving surgery and fusion surgery offer distinct benefits. Fusion is often the go-to procedure for patients with severe degeneration or instability but comes with the risk of adjacent segment degeneration. Motion-preserving surgery, while preserving spine motion and potentially offering better long-term functional outcomes, is more complex and may not be suitable for all patients.

The decision between these two approaches should be based on a thorough assessment of the patient's condition, lifestyle, and long-term goals. [15]

Conclusion

Both spinal fusion and motion preservation surgery have their roles in modern spine surgery. Spinal fusion is a well-established technique with predictable results, particularly for older patients or those with significant spinal degeneration. On the other hand, motion preservation surgery represents a newer approach that may offer advantages for younger and more active patients by maintaining spinal mobility. The choice between these two options depends on factors like the patient's age, activity level, severity of the condition, and long-term goals. Ultimately, a thorough evaluation by a spine surgeon is necessary to determine which procedure is most appropriate for each individual, considering the specific clinical presentation and patient preferences.

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