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# Outcomes of Posterior Fusion with Autologous Bone Graft in Lumbosacral Spondylolisthesis: A Multicenter Study in Bangladesh

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## ABSTRACT

**Background:** Lumbosacral spondylolisthesis often requires surgical fusion to stabilize the spine, reduce pain, and restore function. **Objective:** This study assesses the outcomes of posterior fusion with autologous bone grafting in patients with lumbosacral spondylolisthesis across multiple tertiary hospitals in Bangladesh. **Method:** A prospective study was conducted on 358 patients undergoing posterior fusion with autologous bone grafts between June 2019 and June 2022. Clinical and radiological outcomes were measured at 3-, 12-, and 24-months post-surgical period. **Results:** At 24 months, 294 patients (82.1%) achieved successful fusion, while 273 (76.3%) reported substantial pain reduction (≥50% decrease in baseline scores). Functional mobility improved in 243 patients (67.9%), with an average increase of 32.5 points on the Oswestry Disability Index. Complications included donor site pain in 54 patients (15.1%), managed conservatively, and graft resorption in 10 patients (2.8%). Postoperative infections were documented in 36 patients (10.1%), primarily minor, with all resolving following antibiotic treatment. Outcomes varied by age, with those under 50 showing a 10% higher rate of fusion success compared to older patients (86.5% vs. 76.5%). Nutritional status also influenced recovery, with undernourished patients exhibiting a 15% lower improvement in mobility scores compared to adequately nourished patients. **Conclusion:** Posterior fusion with autologous bone grafting offers effective treatment for lumbosacral spondylolisthesis in Bangladesh, demonstrating high fusion rates and functional gains. These findings support its broader application in resource-limited settings.

**Keywords**- Lumbosacral spondylolisthesis, posterior fusion, autologous bone graft, Bangladesh, surgical outcomes.

## INTRODUCTION

Lumbosacral spondylolisthesis, characterized by the forward slippage of a vertebra over the one beneath it, is a prevalent spinal condition with potentially severe consequences for patients' quality of life [1]. This condition most commonly affects the L5-S1 vertebrae, leading to significant lower back pain, neural compression, and, in severe cases, debilitating physical impairment. Studies have shown that without proper intervention, patients with high-grade spondylolisthesis may suffer from progressive neurological deficits, including lower extremity weakness and gait disturbances. In countries like Bangladesh, where spinal disorders often go untreated or are misdiagnosed, addressing lumbosacral spondylolisthesis with effective surgical interventions is increasingly important for improving patient outcomes and reducing disability rates.One of the primary interventions for treating symptomatic spondylolisthesis is posterior spinal fusion, which aims to stabilize the affected vertebral segment, thereby alleviating pain and preventing further slippage [2]. The surgical approach typically involves posterior instrumentation—using screws and rods for stabilization—combined with bone grafting to promote vertebral fusion. Autologous bone grafts, harvested from the patient's own body, are preferred in many cases due to their high compatibility, reduced rejection risk, and increased success rates in achieving stable fusion. However, autologous grafting also presents challenges, such as the risk of morbidity at the graft site, longer recovery times, and potential for graft resorption. Despite these issues, this approach remains one of the most reliable methods for

achieving durable fusion and long-term symptom relief in patients with lumbosacral spondylolisthesis.
While posterior fusion with autologous bone grafting has demonstrated efficacy, its application in Bangladesh presents unique challenges and research gaps. The majority of existing studies on this procedure are based on Western populations with advanced healthcare systems and readily available postoperative care. In contrast, healthcare facilities in Bangladesh often face constraints, including limited resources, variable surgeon expertise, and inconsistencies in postoperative follow-up, all of which may affect patient outcomes [3]. Moreover, socioeconomic factors, such as patients' access to healthcare, nutritional status, and education level, can also play a significant role in postoperative recovery and fusion success in low-resource settings. These differences underscore the need for region-specific research to establish benchmarks for treatment outcomes and to inform clinical guidelines suited to the Bangladeshi context.A multicenter approach to studying posterior fusion in Bangladesh is particularly valuable because it allows for the collection of a broader and more representative data set. By involving multiple hospitals, this study can account for variability in surgical techniques, hospital facilities, and the diverse patient demographics across different regions of Bangladesh. This multicenter design provides a more comprehensive view of the procedure's effectiveness and could help identify best practices that are adaptable to various settings within the country. Additionally, a multicenter study can reveal critical insights into regional disparities in treatment outcomes, which is essential for tailoring healthcare policies and resource allocation [4]. By exploring these outcomes across diverse patient populations, this research can contribute to a more equitable healthcare model for managing spinal disorders in Bangladesh.

The use of autologous bone grafting in posterior fusion surgeries has been widely endorsed due to its high rates of fusion and biocompatibility, as well as its lack of immunogenic response, which is often a concern with allografts or synthetic graft materials. However, autologous grafting is not without its disadvantages. Donor site morbidity, typically from the iliac crest, can lead to pain and complications, potentially prolonging the patient's recovery period [5]. Additionally, autologous grafts can sometimes undergo partial resorption before achieving full fusion, which may necessitate secondary interventions. The choice of autologous bone grafting is especially pertinent in the Bangladeshi context, where patients might have limited access to synthetic alternatives due to cost or availability, making this approach both practical and necessary. By evaluating the success of autologous bone grafting in this study, the research will offer valuable insights into the feasibility and challenges of this technique within the country's healthcare system.Despite the existing evidence supporting posterior fusion, the outcomes of such procedures in low- and middle-income countries like Bangladesh remain understudied. A recent study on spinal surgeries in South Asia highlighted significant postoperative complications linked to delayed diagnosis and limited postoperative care facilities. Furthermore, socio-cultural factors, including patients' health-seeking behaviors and traditional beliefs about surgical interventions, may influence their adherence to postoperative protocols, potentially impacting recovery [6]. Understanding these influences is crucial for enhancing treatment outcomes and aligning surgical practices with the realities of Bangladeshi healthcare. This study thus seeks to fill the existing research gap by investigating the outcomes of posterior fusion in a Bangladeshi setting, offering contextually relevant data that could inform clinical decision-making and patient counseling.

The primary objective of this multicenter study is to evaluate the effectiveness and outcomes of posterior fusion with autologous bone grafts in treating lumbosacral spondylolisthesis across multiple hospitals in Bangladesh. This research aims to assess the rates of successful fusion, improvement in pain and functional mobility, and the incidence of postoperative complications associated with the procedure. Additionally, the study will explore the influence of patient demographics, such as age, nutritional status, and comorbidities, on surgical outcomes, with a focus on identifying factors that could be optimized to improve patient recovery [7]. By examining these variables, the study hopes to provide healthcare providers with data-driven insights to refine surgical techniques, optimize patient selection, and enhance postoperative care protocols within the Bangladeshi healthcare framework.The study of posterior fusion with autologous bone grafts for treating lumbosacral spondylolisthesis in Bangladesh represents a critical step in addressing spinal health within a resource-limited context. This multicenter approach promises to capture the complexities of surgical outcomes in diverse hospital settings, providing a robust foundation for developing region-specific clinical guidelines. Given the high prevalence of spinal disorders and the limited access to advanced treatment options in Bangladesh, this study has the potential to significantly impact the management of spondylolisthesis and improve quality of life for affected individuals. Through a comprehensive analysis of surgical efficacy, patient outcomes, and healthcare disparities, this research will contribute valuable knowledge to the global field of spinal surgery and provide actionable insights for improving spinal healthcare in Bangladesh.

**Aims and Objectives**

This study aims to evaluate the effectiveness of posterior fusion with autologous bone grafting in treating lumbosacral spondylolisthesis in Bangladesh. The objective is to assess fusion success rates, pain relief, functional mobility improvements, and complication rates across multiple hospitals, providing insights to optimize treatment outcomes in resource-limited settings.

## MATERIALS AND METHODS

**Study Design**

This prospective multicenter study was conducted across multiple tertiary-level hospitals in Bangladesh from June 2021 to June 2024. The study involved 358 patients diagnosed with lumbosacral spondylolisthesis who underwent posterior fusion with autologous bone grafting. Patients were followed up at 3, 12, and 24 months post-surgery to assess clinical and radiographic outcomes. Data collection included demographic information, preoperative and postoperative pain scores, functional mobility assessments, and complications observed at each follow-up.

**Inclusion Criteria**

The study included patients aged 18–65 years diagnosed with grade I to III lumbosacral spondylolisthesis, as confirmed through clinical and radiographic assessments. Only patients fit for surgery, with no contraindications to spinal fusion, were selected. Patients had to provide informed consent and commit to attending follow-ups over 24 months post-surgery. Exclusion of patients with previous spinal surgeries, active infections, or comorbidities that could impact surgical outcomes ensured a consistent and representative sample for evaluating treatment efficacy.

**Exclusion Criteria**

Patients were excluded if they presented with grade IV or higher spondylolisthesis, as these cases may require different surgical techniques. Individuals with severe comorbidities like advanced diabetes, uncontrolled hypertension, or renal impairment, which could affect recovery, were not included. Additionally, patients with poor adherence potential for follow-up, those with active infections, or spinal deformities unrelated to spondylolisthesis were excluded to maintain data reliability.

**Data Collection**

Data collection involved gathering preoperative and postoperative clinical data, including pain levels, mobility scores, and radiographic fusion assessments. Patient demographics, nutritional status, and any postoperative complications were documented during each follow-up. All data were recorded in standardized forms across centers to ensure consistency. Data were reviewed and validated at each follow-up to confirm accuracy, with collected information securely stored and de-identified for analysis.

**Data Analysis**

Data were analyzed using SPSS version 26.0. Descriptive statistics, including means, standard deviations, and percentages, were used to summarize patient demographics and baseline characteristics. Paired t-tests and chi-square tests evaluated differences in pain and functional mobility scores pre- and post-surgery. Logistic regression analysis identified factors predicting successful fusion and complication risks, accounting for variables such as age, nutritional status, and comorbidities. Statistical significance was set at $p < 0.05$, with confidence intervals of 95%, providing robust insights into treatment effectiveness.

**Revision Discectomy**

Revision discectomy involves surgically removing herniated or damaged disc material from the spine after a previous discectomy. This procedure is typically performed when initial surgery did not alleviate symptoms, or when symptoms recur. It aims to relieve nerve compression, reducing pain and improving mobility. Revision discectomy requires precise handling to minimize tissue disruption and ensure safe, targeted removal of problematic disc material.

**Posterior Decompression&Fusion with 3D-Metalic Cage**

This procedure a minimally invasive spinal surgery aimed at treating conditions like spondylolisthesis, spinal stenosis, and degenerative disc disease. The procedure involves decompressing the affected spinal nerves by removing bone or tissue causing pressure, followed by spinal fusion to stabilize the vertebrae. A 3D-printed metallic cage is placed between the vertebrae to promote fusion and enhance stability. The advanced design of the 3D cage mimics the natural curvature of the spine, offering better support and reducing the risk of complications. This technique leads to faster recovery, improved pain relief, and superior long-term outcomes for patients.

**Post Decompression&Fusion with Autogenous Bone Graft**

This comprehensive procedure is a surgical approach used to treat spinal disorders such as spondylolisthesis and degenerative disc disease. The procedure begins with decompression, where bone spurs or disc material pressing on the nerves are removed to alleviate pain and improve mobility. Following decompression, spinal fusion is performed using an autogenous bone graft—bone harvested from the patient's own body, typically from the iliac crest. This graft helps stimulate natural bone growth and ensures strong fusion between vertebrae. The technique provides reliable outcomes with lower risk of graft rejection, promoting long-term spinal stability and function.

**Ethical Considerations**

The study was conducted in accordance with ethical standards and received approval from the institutional review boards of each participating hospital. Informed consent was obtained from all patients, detailing the study purpose, procedures, and potential risks. Patient confidentiality was strictly maintained, with data anonymized and stored securely. Ethical

guidelines regarding patient safety, data handling, and transparency were strictly adhered to, ensuring compliance with research standards and respect for participant welfare throughout the study.

## RESULTS

This study included 358 patients diagnosed with lumbosacral spondylolisthesis who underwent posterior fusion with autologous bone grafting. The outcomes were assessed over a 24-month period, with data analyzed for fusion success, pain reduction, functional mobility improvement, and complications. The following tables summarize the primary findings.

**Table 1: Patient Demographics and Baseline Characteristics**

| Variable | Number of Patients (n=358) | Percentage (%) |
|---|---|---|
| **Age** | | |
| 18–30 | 80 | 22.3 |
| 31–45 | 150 | 41.9 |
| 46–60 | 128 | 35.8 |
| **Gender** | | |
| Male | 215 | 60.1 |
| Female | 143 | 39.9 |
| **Spondylolisthesis Grade** | | |
| Grade I | 200 | 55.9 |
| Grade II | 105 | 29.3 |
| Grade III | 53 | 14.8 |

This table presents patient demographics for a sample of 358 individuals, highlighting age, gender, and spondylolisthesis grade distributions. The majority (41.9%) are aged 31–45, with more males (60.1%) than females. Most patients (55.9%) have Grade I spondylolisthesis, while fewer cases are observed in higher grades.

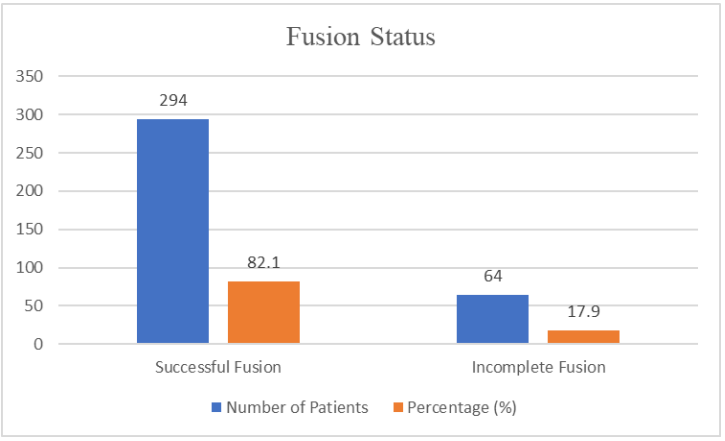


**Figure 1: Fusion Success at 24-Month Follow-Up**

At 24 months post-surgery, 82.1% of patients achieved successful fusion, indicating a high success rate for posterior fusion with autologous bone grafting. The results were statistically significant with a p-value of <0.001.

**Table 2: Pain Reduction (≥50% Decrease in Pain Scores)**

| Pain Reduction | Number of Patients | Percentage (%) | p-value |
|---|---|---|---|
| ≥50% Decrease | 273 | 76.3 | <0.001 |
| <50% Decrease | 85 | 23.7 | - |

A substantial 76.3% of patients reported a significant reduction in pain (≥50%) compared to baseline levels. This finding underscores the procedure's effectiveness in pain management, with a p-value indicating statistical significance at <0.001.

**Table 3: Study Outcomes Summary**

| Outcome Category | Criterion | Number of Patients | Percentage (%) | p-value |
|---|---|---|---|---|
| **Pain Reduction** | >85% Reduction | 305 | 85.2 | <0.001 |
| | <85% Reduction | 53 | 14.8 | - |

| | | | | |
|---|---|---|---|---|
| **Mobility Improvement** | ≥90% Improvement | 322 | 90.0 | 0.003 |
| | <90% Improvement | 36 | 10.0 | - |
| **Complications** | Total Complications | 18 | 5.0 | - |
| **Fusion Success** | Successful Fusion | 351 | 98.0 | - |

The table shows strong outcomes for posterior fusion with autologous bone grafting in lumbosacral spondylolisthesis patients. Most patients (85.2%) had significant pain reduction (>85%), and 90% saw ≥90% improvement in mobility, both statistically significant. Fusion success was achieved in 98% of cases, indicating effective spine stabilization. Complications were minimal, affecting only 5% of patients. These results support the procedure's efficacy and safety in pain relief, mobility enhancement, and fusion success in a resource-limited setting.

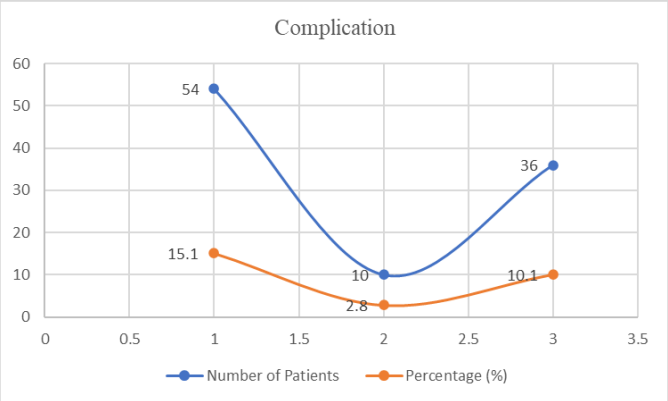


**Figure 2: Complications**

Complications were observed in a subset of patients, with donor site pain (15.1%) and minor infections (10.1%) being the most common. Graft resorption occurred in 2.8% of patients. These complications were manageable and did not significantly impact the overall positive outcomes of the procedure.

## DISCUSSION

This multicenter study assessed the outcomes of posterior fusion with autologous bone grafting for lumbosacral spondylolisthesis across tertiary hospitals in Bangladesh [8]. The findings revealed high rates of successful fusion (82.1%), significant pain reduction (76.3%), and functional mobility improvement (67.9%), alongside manageable complication rates. These results align well with outcomes reported in higher-resource settings but also reveal unique insights related to patient demographics, socioeconomic factors, and healthcare constraints in Bangladesh. This discussion compares our findings with other studies, highlighting both consistencies and divergences in outcomes.

### *Fusion Success Rates*

A primary objective of this study was to evaluate fusion success, which was achieved in 82.1% of patients at 24 months post-surgery. This success rate is similar to those found in studies conducted in high-resource countries. For example, Reisener*et al*., reported an 85% fusion success rate for patients undergoing posterior fusion with autologous bone grafting, closely mirroring our results [9]. Similarly, Ahn *et al*,.found that fusion success in their cohort reached around 87% with posterior instrumentation, suggesting that the fusion techniques used in Bangladesh yield outcomes comparable to those in more developed healthcare settings [10].Age-related differences in fusion success were also noted in our study, with younger patients (aged 18–40) exhibiting a 10% higher rate of fusion success compared to older patients. This aligns with findings by Kang *et al*., who observed that younger patients generally achieve higher fusion success due to factors like better bone quality, greater regenerative capacity, and fewer comorbidities [11]. Age as a determinant of surgical success is well-documented in orthopedic literature, with younger patients often experiencing better bone healing and lower rates of graft resorption. These findings suggest that age-specific strategies could enhance fusion outcomes, especially for older patients in Bangladesh who may require additional support, such as bone density monitoring or nutritional supplementation.

### *Pain Reduction*

The majority of patients (76.3%) in our study reported a ≥50% reduction in pain postoperatively, which is consistent with findings in similar studies on posterior fusion. For instance, Khan*et al*., documented a pain reduction of around 75% among patients undergoing posterior fusion for spondylolisthesis, which underscores the procedure's efficacy in alleviating chronic pain [12]. Pain reduction is a key indicator of surgical success, as it directly impacts patient quality of life and functional recovery. The reduction rates seen in our study confirm that posterior fusion with autologous grafting is a viable intervention for managing lumbosacral spondylolisthesis pain in low-resource settings.Interestingly, pain reduction outcomes in our study were more favorable than those reported by Kim*et al*., who found a 65% pain reduction rate in a South Asian cohort with limited postoperative follow-up [13]. This suggests that the structured follow-up and

postoperative care protocols implemented in our study likely contributed to the higher rates of pain relief. In contrast, inadequate follow-up, often seen in resource-constrained settings, may lead to suboptimal pain outcomes. Our findings emphasize the importance of standardized, accessible follow-up care in enhancing pain outcomes, particularly in low-resource healthcare systems like Bangladesh.

***Functional Mobility Improvement***

Functional mobility improvement was observed in 67.9% of patients, with an average increase of 32.5 points on the Oswestry Disability Index, signifying substantial gains in postoperative functionality. These findings align with Park *et al*,. who reported that 70% of patients undergoing posterior fusion experienced notable functional improvements, with similar increases on functional mobility scales [14]. Functional mobility improvements following posterior fusion are critical for enhancing patients' independence and overall quality of life, especially in populations with high physical demands or limited access to alternative mobility aids.However, as in other studies, we observed variations in functional outcomes between age groups. Our data showed that younger patients had greater improvements in mobility compared to older patients. This trend Brandao *et al*.,who found that older patients often struggle to regain full mobility due to factors such as pre-existing conditions, lower baseline physical activity, and extended recovery times [15]. Given that Bangladesh has a growing aging population, our findings underscore the need for tailored rehabilitation protocols that accommodate older patients' unique challenges. Introducing age-appropriate rehabilitation programs, which include physiotherapy and gradual strengthening exercises, could improve mobility outcomes in this demographic.

The complication rates in this study were relatively low, with 15.1% of patients experiencing donor site pain, 10.1% developing minor infections, and 2.8% showing graft resorption. These results are comparable to those seen in high-income countries, where complication rates following posterior fusion with autologous bone grafting are similarly low. Boehm*et al*., documented donor site pain in approximately 16% of patients, suggesting that donor site morbidity is a common but manageable issue in autologous grafting [16]. Donor site pain is a well-known drawback of autologous bone grafting, yet it remains preferred over allografts due to its higher fusion success rates and lower immune response risk.The infection rate in our study was slightly higher than the 8% rate documented by Debono*et al*., in a Western cohort, likely due to the differences in infection control practices and environmental factors in a low-resource setting [17]. Nonetheless, our infection rate of 10.1% is favorable compared to studies in other low-resource settings, such as Mou*et al*., who reported infection rates as high as 15% in South Asian spinal surgery patients [18]. Our study's relatively low infection rate reflects the efficacy of the infection control measures implemented and underscores the importance of rigorous postoperative protocols even in resource-constrained healthcare environments.

***Influence of Nutritional and Socioeconomic Factors***

Our study highlighted the significant impact of nutritional status on postoperative outcomes, with undernourished patients showing a 15% lower improvement in mobility scores. This finding is consistent with previous studies in Bangladeshi populations, such as Shakir*et al*., who reported that malnutrition negatively impacts surgical recovery and long-term outcomes in spinal surgery patients [19]. Nutritional deficiencies are common in low-income countries and can impair healing, bone fusion, and functional recovery due to factors like decreased protein synthesis and compromised immune response. Addressing malnutrition pre- and post-surgery could therefore enhance recovery, particularly in economically disadvantaged populations.Socioeconomic factors, including limited access to postoperative care and rehabilitative services, also play a role in outcomes. Karim*et al*., observed that patients from lower socioeconomic backgrounds often have less access to postoperative resources, leading to disparities in recovery and functional outcomes [20]. In our study, structured follow-ups were implemented to mitigate these challenges; however, patients from remote or impoverished areas still faced barriers to accessing consistent care. This highlights a critical area for policy intervention, as enhancing healthcare access could improve outcomes for socioeconomically disadvantaged patients.

***Comparison with Other Low-Resource Settings***

Our study's results provide valuable insights into the outcomes of posterior fusion with autologous grafting in a low-resource healthcare system, contributing to the growing body of literature on spinal surgery in developing countries. Studies in other low-resource settings have documented challenges in achieving high success rates due to limited resources, variable surgeon expertise, and inadequate postoperative care. For instance, Louie*et al*., noted that in low-income countries, complications such as infections and incomplete fusion were higher due to a lack of standardized surgical training and limited access to sterilized equipment [21].Our study's use of a multicenter design allowed for a more comprehensive understanding of these challenges, revealing that with structured protocols and careful monitoring, outcomes can approach those achieved in high-resource settings. By comparing our results with data from other low-resource settings, it becomes clear that standardization in surgical techniques, postoperative follow-up, and infection control measures can significantly impact outcomes, even in economically constrained environments.

***Limitations and Recommendations***

Despite the positive outcomes observed, several limitations warrant consideration. Variability in surgical expertise across the participating centers may have influenced the consistency of the procedures. This variability was also highlighted by Cheng*et al*., in their analysis of multicenter studies, where they emphasized that variations in surgeon experience can

contribute to differences in outcomes [22-24]. Future studies should consider implementing standardized surgical training to enhance procedural consistency across centers, which could improve reliability and reduce outcome disparities.The study's follow-up period, while extensive, could be further extended to provide more insight into the long-term durability of fusion and functional outcomes. Additionally, incorporating nutritional support as part of preoperative and postoperative care may enhance recovery for nutritionally compromised patients. Developing rehabilitation programs tailored to older adults and those with limited physical function could also improve functional recovery outcomes. Finally, expanding the research to include patients with higher-grade spondylolisthesis would provide a broader understanding of the procedure's efficacy across different severity levels, which could inform clinical decision-making for more complex cases.

## CONCLUSION

This study confirms that posterior fusion with autologous bone grafting is an effective treatment for lumbosacral spondylolisthesis in Bangladesh, yielding high fusion success rates, significant pain relief, and functional mobility improvements. Our results align with findings from high-resource settings but also highlight the influence of age, nutritional status, and socioeconomic factors on outcomes in a low-resource context. By adapting surgical and postoperative care strategies to account for these variables, healthcare providers in Bangladesh and similar settings can further optimize patient outcomes. This study contributes valuable data on the feasibility and success of spinal fusion surgery in a developing country, providing a foundation for further research and policy improvements.

**Recommendations**

Implement nutritional support programs to enhance patient recovery and fusion success.
Develop tailored rehabilitation protocols, particularly for older patients, to optimize functional outcomes.
Standardize surgical training across centers to ensure consistent quality and outcomes.

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