# SURGICAL OUTCOMES OF LUMBAR STENOSIS PATIENTS WITH OSTEOPOROSIS AT HANOI MEDICAL UNIVERSITY HOSPITAL

**Dinh Manh Hai[1,2], Nguyen Thanh Tam[2], Nguyen Thi Thu Huyen[2]**
**Le Thanh Hien[2], Cao Phuong Chi[2] and Nguyen Hoai Nam[1,✉]**
*[1]Hanoi Medical University*
*[2]Hanoi Medical University Hospital*

*We conducted a case series study on patients with lumbar spinal stenosis (LSS) and osteoporosis who underwent decompression and posterolateral fusion (PLF) at Hanoi Medical University Hospital over a 2-year period from September 2022 to September 2024. A total of 70 patients were included. The mean age was 67.61 ± 8.3 years old (range 43–82), with a female-to-male ratio of 2.5:1. Radiological findings revealed ligamentum flavum hypertrophy in 75.71%, disc height reduction in 71.43%. The most commonly affected level was L4–L5 (87.14%). Clinical outcomes showed significant improvement: mean VAS scores decreased from 6.8 ± 2.2 to 2.3 ± 0.9 for back pain and from 6.6 ± 2.3 to 1.9 ± 0.7 for leg pain. The Oswestry Disability Index (ODI) improved from 42.3% ± 12.6 preoperatively to 15.5% ± 6.6 at 6 months postoperatively (p < 0.001). The mean operative time was 138 ± 20 minutes (range 110–180), with mean intraoperative blood loss of 280 ± 21ml (225 – 350). The overall complication rate was 4.3%. The mean hospital stay was 7.4 ± 1.1 days (5 – 10), and the mean time to ambulation after surgery was 3.5 ± 1.1 days (2 – 6). At 12 months, the results improved further, with excellent outcomes in 45.5%, good in 37.9%, and fair in 16.6%. Surgical decompression combined with posterolateral fusion (PLF) in osteoporotic patients with LSS resulted in significant improvements in pain and functional outcomes, with acceptable fusion rates and manageable complication risks.*

**Keywords: Lumbar spinal stenosis, osteoporosis, posterolateral fusion.**

## I. INTRODUCTION

Lumbar spinal stenosis (LSS) is among the most common degenerative disorders in the elderly population. It is characterized by narrowing of the spinal canal caused by intervertebral disc degeneration, facet joint hypertrophy, ligamentum flavum thickening, or spondylolisthesis, leading to compression of neural elements. Clinically, patients typically present with chronic low back pain radiating to the lower extremities, often accompanied by neurogenic claudication, which significantly limits mobility and impairs quality of life.[1] The prevalence of LSS continues to rise in the context of global population aging, representing a considerable public health burden worldwide.

Surgical decompression combined with fixation and fusion is generally indicated when patients no longer respond to conservative management. Among current surgical techniques, transforaminal lumbar interbody fusion (TLIF) and posterolateral fusion (PLF) are the most commonly performed. TLIF offers superior biological stability by providing direct bone grafting between vertebral bodies;

*Corresponding author: Nguyen Hoai Nam*
*Hanoi Medical University*
*Email: nguyennamthhd8@gmail.com*
*Received: 30/09/2025*
*Accepted: 03/11/2025*

however, it requires advanced surgical expertise, is associated with longer operative times, increased blood loss, and carries a higher risk of cage subsidence, particularly in patients with reduced bone mineral density.

In contrast, PLF is technically simpler, less invasive, requires shorter operative time, and may be more suitable for patients with osteoporosis. Although its initial mechanical stability is inferior to that of TLIF, PLF can still achieve satisfactory fusion outcomes when combined with pedicle screw fixation.[2] Therefore, PLF represents a feasible surgical option for the treatment of LSS, especially in elderly patients with concomitant osteoporosis.

Osteoporosis is a common metabolic bone disease, particularly prevalent among postmenopausal women and the elderly. Reduced bone mineral density leads to microarchitectural deterioration of bone, directly compromising the stability of pedicle screw fixation in spinal surgery.[3] In patients with LSS and osteoporosis, the risks of screw loosening, screw breakage, nonunion, and revision surgery are markedly increased. These challenges underscore the importance of selecting an appropriate surgical approach and evaluating its long-term effectiveness. Accordingly, this study aimed to describe the clinical and paraclinical characteristics of patients with lumbar spinal stenosis and osteoporosis, and to evaluate the outcomes of decompression and spinal fixation surgery in this population.

## II. MATERIALS AND METHODS

### 1. Subjects

Seventy patients diagnosed with lumbar spinal stenosis (LSS) and osteoporosis who met the inclusion criteria were enrolled in this study.

***Inclusion criteria:***

Patients diagnosed with LSS and osteoporosis based on clinical findings and radiological imaging (X-ray and MRI), who underwent posterior decompression, pedicle screw fixation, and posterolateral bone graft fusion.

Patients were followed intraoperatively and postoperatively for at least 12 months, and all evaluations were performed using standardized assessment tools.

***Exclusion criteria***

Patients with comorbidities that could affect treatment outcomes, such as ankylosing spondylitis, spinal tuberculosis, neuromuscular diseases, or acute/chronic peripheral vascular disease.

Patients with incomplete medical records or those lost to follow-up.

### 2. Methods

***Study design:*** A descriptive, retrospective and prospective uncontrolled study.

***Study setting and duration:*** The study was conducted from September 2022 to September 2024 at the Department of Neurosurgery – Spine Surgery, Hanoi Medical University Hospital.

***Research instruments:*** A structured questionnaire consisting of two parts:

*Part 1:* Basic demographic and clinical information (including name, age, gender, occupation, preoperative diagnosis, operative time, length of hospital stay, surgical site, medical history, etc.). All patients underwent the same surgical technique: posterior decompression, pedicle screw fixation, and posterolateral fusion.

*Part 2:* Standardized assessment tools for pre- and postoperative evaluation:

Pain intensity measured using the Visual Analog Scale (VAS).

Functional disability of the lumbar spine assessed using the Oswestry Disability Index (ODI).[4]

Radiographic fusion evaluated according to

the Bridwell fusion grading system.[5]

Surgical outcomes and patient satisfaction assessed using the Macnab criteria.[6]

Data analysis: Data were processed and analyzed using SPSS version 22. The normality of data distribution was tested using the Kolmogorov–Smirnov test. Descriptive statistics, including frequency, mean, and percentage, were applied as appropriate.

**3. Research ethics**

All patients provided informed consent prior to participation. Participation was entirely voluntary, and patients retained the right to withdraw at any stage of the study. Patient information was kept strictly confidential and used solely for research purposes. The study was conducted without affecting the quality of hospital care, patient health, or financial interests, and was approved by Hanoi Medical University Hospital.

## III. RESULTS

**1. Characteristics of study subjects**

The number of female patients was higher than male patients, with a female-to-male ratio of 2.5. The majority of patients were elderly, with a mean age of 67.61 ± 8.3 years old (range: 43 - 82 years). The mean duration from symptom onset to hospital admission was 7.92 ± 5.57 (1 - 25) months, and most patients were admitted due to poor response to conservative treatment. The predominant clinical manifestations were low back pain (81.43%) and neurogenic claudication (71.43%). The most commonly affected level was L4–L5 (87.14%), attributable to the greater range of motion and mechanical loading at this segment. On MRI, the primary degenerative changes of the lumbar spine included ligamentum flavum hypertrophy (75.71%), disc height reduction (71.43%), and facet joint hypertrophy (68.57%).

**2. Intraoperative and postoperative course**

The mean operative time was 138 ± 20 (110 - 180) minutes, with an average intraoperative blood loss of 280 ± 21 (225 - 350) ml. Intraoperative complications included one case of pedicle screw placement into the superior endplate. The mean length of hospital stay was 7.4 ± 1.1 (5 - 10) days, and the mean time to ambulation after surgery was 3.5 ± 1.1 (2 - 6) days.

**3. Surgical outcomes**

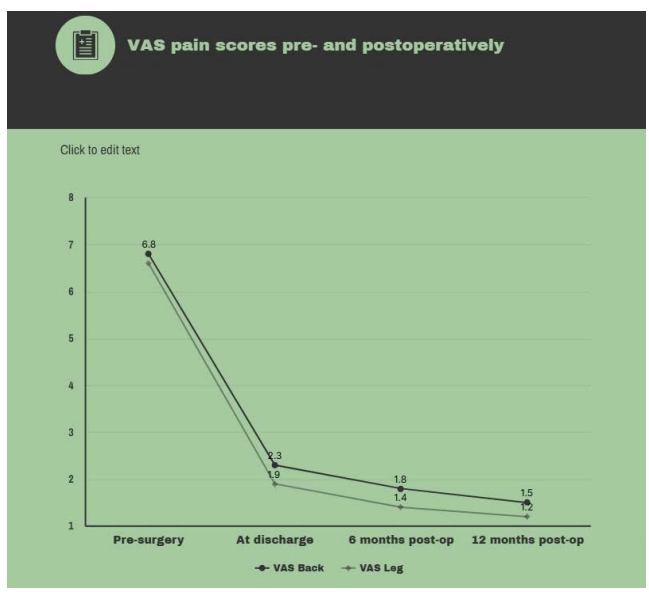


**Figure 1. Comparison of VAS pain scores before and after surgery**

Immediately after surgery, patients experienced significant improvement in both low back pain and leg pain. The absence of interbody fusion minimized vertebral body injury, while direct decompression of the nerve roots allowed for clear visualization and control of the ligamentum flavum and nerve roots. Wide decompression of the spinal canal effectively reduced back pain and markedly improved leg pain. Postoperative radiographs obtained in all patients prior to hospital discharge demonstrated that 100% of pedicle screws were correctly positioned.

***Surgical outcomes at 6 months postoperatively***

At 6 months postoperatively, in addition to pain assessment, we evaluated the degree of functional limitation of the lumbar spine using the Oswestry Disability Index (ODI), and assessed spinal fusion status based on the Bridwell grading system through dynamic X-ray imaging.

**Table 1. Assessment of fusion status (Bridwell), surgical outcomes (Macnab criteria), and functional limitation (ODI) at 6 months postoperatively (n = 70)v**

| | **Fusion grade** | **Number (n)** | **Percentage (%)** |
|---|---|---|---|
| *Fusion status (Bridwell classification)* | Grade I | 12 | 17,1 |
| | Grade II | 26 | 37,2 |
| | Grade III | 28 | 40 |
| | Grade IV | 4 | 5,7 |
| | Total | 70 | 100 |
| | **Grade** | **Number (n)** | **Percentage (%)** |
| *Surgical outcomes (Macnab criteria)* | Very good | 23 | 32,9 |
| | Good | 27 | 38,5 |
| | Medium | 18 | 25,7 |
| | Bad | 2 | 2,9 |
| | Total | 70 | 100 |
| ***ODI*** | **Disability level** | **Number (n)** | **Percentage (%)** |
| *Preoperative ODI* | Minimal | 0 | 0 |
| | Moderate | 33 | 47,1 |
| | Severe | 29 | 41,4 |
| | Crippled | 8 | 11,4 |
| | Bed-bound or exaggerating | 0 | 0 |

| *ODI* | Disability level | Number (n) | Percentage (%) |
|---|---|---|---|
| *Postoperative ODI (6 months)* | Minimal | 58 | 82,9 |
| | Moderate | 12 | 17,1 |
| | Severe | 0 | 0 |
| | Crippled | 0 | 0 |
| | Bed-bound or exaggerating | 0 | 0 |
| Mean preoperative ODI | | 42,3 ± 12,6 (28 – 68) | |
| Mean postoperative ODI (6 months) | | 15,5 ± 6,6 (8 – 25) | |

At 6 months postoperatively, 54.3% of patients demonstrated satisfactory posterolateral fusion with a combination of autologous bone and bone substitute grafting. Evaluation by the Macnab criteria showed that 71.4% of patients achieved good or excellent outcomes. Most patients returned to normal daily activities; one patient continued to experience persistent radicular pain secondary to a postoperative wound infection. Functional impairment of the lumbar spine also improved markedly: the mean Oswestry Disability Index (ODI) decreased from 42,3 ± 12,6 (28 – 68) preoperatively to 15,5 ± 6,6 (8 – 25) at 6 months after surgery.

**Table 2. Correlation between change in ODI score at 6 months postoperatively and age, sex, and number of affected levels**

| Variable | | ΔODI (Mean ± SD) | p-value |
|---|---|---|---|
| *Age* | < 75 years | 28 ± 13,75 | 0,631 |
| | ≥ 75 years | 26,67 ± 17,43 | |
| *Gender* | Male | 24 ± 16,73 | 0,136 |
| | Female | 30 ± 13,05 | |
| *Number of affected levels* | ≤ 2 levels | 33,96 ± 11,62 | 0,002 |
| | > 2 levels | 21,24 ± 15,04 | |

***Surgical outcomes at 12 months postoperatively***

At 12 months postoperatively, follow-up evaluations were performed in 66 patients (94%), yielding the following results in Table 3.

At the 6-month follow-up, two patients continued to experience low back pain and radicular symptoms; however, by the 12-month evaluation, both had fully recovered with the use of pharmacological therapy, physical rehabilitation, and modification of adverse lifestyle habits affecting the spine.

**Table 3. Surgical outcomes at 12 months postoperatively according to Macnab criteria (n = 66)**

| Grade | Number (n) | Percentage (%) |
|---|---|---|
| Very good | 30 | 45,5 |
| Good | 25 | 37,9 |
| Medium | 11 | 16,6 |
| Bad | 0 | 0 |
| Total | 66 | 100 |

## IV. DISCUSSION

The mean age of the study cohort was 67,61 ± 8,30 (43 - 82) years old, which is consistent with the clinical profile of lumbar spinal stenosis (LSS), a degenerative condition commonly seen in the elderly. Advanced age may be associated with decreased bone mineral density, which can negatively impact screw fixation, bone fusion, and postoperative recovery following posterolateral fusion (PLF). The proportion of female patients was higher than male patients, which may be attributed to postmenopausal estrogen deficiency leading to osteoporosis and thereby accelerating degenerative changes. In this study, hypertrophy of the ligamentum flavum was observed in 75.71% of cases, decreased disc height in 71.43%, and facet joint hypertrophy in 68.57%. These degenerative changes are the principal factors contributing to spinal canal narrowing and neural foraminal stenosis.[7]

The mean operative time was 138 ± 20 minutes, with an average intraoperative blood loss of 138 ± 20 (110 – 180) ml. Patients undergoing multilevel decompression were at greater risk of increased blood loss. The operative time in our series was comparable to that reported internationally, ranging from 150 to 180 minutes, whereas intraoperative blood loss was lower. Abdelaziz et al. (2020) reported an average blood loss of 457 ± 193.8 ml.[8] These findings highlight the effectiveness of posterolateral fusion compared with interbody fusion, demonstrating shorter operative times and reduced blood loss, as the intervertebral disc does not need to be removed. Common bone grafting methods include autografts, allografts, artificial bone substitutes, and osteoinductive materials. Among these, autologous bone grafts—typically harvested from the posterior iliac crest—are still considered the ‘gold standard’ because they provide all three essential components for bone healing: osteogenesis, osteoinduction, and osteoconduction. However, in osteoporotic patients, the osteogenic potential of autografts is reduced, while iliac crest harvesting increases the risk of fracture or chronic donor site pain. Therefore, in this study, we used local autologous bone obtained during decompression combined with artificial bone substitutes for posterolateral fusion.

Intraoperative complications included one case of pedicle screw placement breaching the superior endplate and two cases of surgical site infection, yielding an overall complication rate of 4.3%. No case of dural tear or nerve root injury was observed, underscoring the advantages of this surgical technique, which

allows wide exposure without disc removal, thereby minimizing risks of neural and dural injury.

The mean length of hospital stay was 7.4 ± 1.1 (5 – 10) days, and the average time to ambulation was 3.5 ± 1.1 (2 – 6) days. Gruskay et al. (2015) reported a hospital stay ranging from 3 to 7 days, depending on the number of decompressed levels.[9] Early drain removal, combined with functional rehabilitation and adequate pain management, may further shorten hospitalization time.

Lumbar spinal stenosis with nerve root compression results in neurological impairment. In our series, 100% of patients presented with spinal syndrome, with mean preoperative back pain and radicular leg pain scores of 6.8 and 6.6 on the VAS scale, respectively, indicating the severity of the disease and its substantial impact on spinal function (mean ODI: 42.3%). Postoperatively, the mean VAS scores for back and leg pain decreased markedly to 2.3 and 1.9, respectively, demonstrating significant symptomatic relief immediately after surgery. These findings are consistent with previous studies on the outcomes of spinal decompression and fixation surgery.[10] With open procedures, postoperative pain can sometimes be confounded by wound pain or muscle trauma, which may be mistaken for instability-related pain, making early evaluation during hospitalization less reliable.

At 6 months postoperatively, the mean VAS scores for back and leg pain further improved to 1.8 and 1.4, while the mean ODI decreased to 15.5. These outcomes are in line with previous reports showing that PLF effectively reduces pain and improves functional mobility.[11] The improvements in back pain, radicular pain, and functional limitation were statistically significant ($p < 0.01$). Patient satisfaction, assessed using Macnab's criteria at 6 months, revealed outcomes rated as excellent in 32.9% of cases, good in 38.5%, fair in 25.7%, and poor in 2.9%.

At 6 months postoperatively, there was no significant difference in ODI improvement across different age groups. However, over time, patients aged ≥ 75 years tended to have higher ODI scores, likely attributable to age-related factors such as reduced self-care capacity, limited mobility, and impaired sleep quality.[12] Furthermore, no correlation was found between postoperative ODI outcomes and gender , suggesting that functional improvement was comparable between male and female patients, consistent with findings from other international studies.[13] Notably, the number of operated levels significantly influenced ODI improvement. Patients undergoing multilevel fusion demonstrated less favorable functional outcomes. Similar results were reported by Lee (2011).[14] This may be explained by reduced spinal flexibility due to extensive fixation, as well as prolonged recovery time associated with greater soft-tissue trauma, longer operative duration, and increased intraoperative blood loss, all of which can negatively impact early mobilization.

At the 6-month follow-up, radiographic assessment demonstrated a fusion rate of 54.3%. Faulks (2025) reported a comparable rate of 55.7% at the same interval.[15] Posterolateral fusion generally achieves high long-term fusion rates (~88–93%) within 1–2 years, approaching the efficacy of interbody fusion techniques such as TLIF, despite a relatively modest early fusion rate at 6 months.[16] Importantly, this figure is expected to improve substantially with longer follow-up.

At the 12-month follow-up, 66 patients (94%) were successfully re-evaluated, with 83.4% achieving good to excellent outcomes.

All patients demonstrated marked improvement in clinical symptoms. Notably, two patients who experienced residual back pain and radicular symptoms at 6 months showed complete recovery by 12 months with appropriate medical therapy, rehabilitation exercises, and lifestyle modifications to reduce adverse mechanical stress on the spine.

## V. CONCLUSION

Posterolateral fusion with spinal fixation and decompression is an effective surgical method for managing lumbar spinal stenosis in patients with osteoporosis, providing significant relief of back and leg pain immediately after surgery and sustaining long-term benefits. The use of posterolateral bone grafting, combining autologous laminar cancellous bone with artificial graft material, achieved satisfactory fusion outcomes. In elderly and osteoporotic patients, avoiding interbody fusion reduces operative time and blood loss, while minimizing vertebral body and neural injury associated with disc removal. Compared with TLIF, PLF is technically simpler, less invasive, and associated with shorter operative duration and reduced intraoperative blood loss, making it more suitable for elderly or osteoporotic patients. However, TLIF may yield higher fusion rates, particularly in cases requiring restoration of sagittal alignment or multilevel fusion. Therefore, long-term studies with larger cohorts comparing PLF and TLIF are warranted to better assess the durability of spinal fixation and the long-term functional outcomes in patients.

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