ORIGINAL ARTICLE

# Functional Outcomes of Posterior Decompression in Patients with Neurogenic Claudication Due to Lumbar Canal Stenosis

Rex Chandrabose[1], Vijaya Anand S[2], Satish Kumar[3], Prem Anand[4], Harish Kumar[5]

## Abstract

**Background:** Degenerative lumbar canal stenosis is one of the frequently encountered problem in elderly. The long-term outcomes of posterior spinal decompression (PSD) on relief of neurogenic claudication (NC) due to lumbar canal stenosis remain unclear. The aim of our study is to assess the functional outcomes of posterior decompression in patients with NC due to lumbar canal stenosis eliminating various heterogeneous factors.

**Materials and methods:** A longitudinal prospective study conducted in 20 patients of homogenous group of age 60–80 years and other medical conditions who had undergone PSD from June 2018 to May 2020 at Rex Ortho Hospital adhering to inclusion and exclusion criteria with stable spine. Patients were assessed with Neurogenic Claudication Outcome Score (NCOS) and Japanese Orthopedic Association Score (JOAS) at preoperative and postoperative period.

**Results:** At the end of first year 85% had excellent outcome, 10% had good outcome, and 5% had fair outcome based on NCOS and JOAS. No patients had poor outcome or resurgery. Delayed wound healing was in one patient, and no radiological changes such as instability or further degenerative changes were identified.

**Conclusion:** Posterior spinal decompression in patients with NC due to isolated lumbar canal stenosis yields excellent results based on NCOS and JOAS. Selection of patient is very important and careful assessment of other associated local or general problem may influence the outcome.

**Keywords:** Lumbar canal stenosis, Neurogenic claudication, Neurogenic Claudication Outcome Score, Posterior decompression.

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## Introduction

Degenerative lumbar canal stenosis is one of the common causes of low back pain and NC in elderly patients. Also, it is a common cause of disability in elderly, requiring surgery for its treatment.[1–3] Degenerative lumbar canal stenosis is narrowing of the spinal canal or intervertebral foramina in the lumbar spine secondary to degenerative changes. It is a result of progressive bone or ligament hypertrophy (or both) in local, segmental, or generalized regions, which results in the compression of spinal nerves and nerve roots, causing variable symptoms, which includes low back pain, lower extremity radiculopathy, NC, and gait impairment.[4] Neurogenic claudication is the clinical syndrome associated with symptomatic lumbar spinal stenosis (LSS). It is characterized by bilateral or unilateral buttock, thigh or calf discomfort, pain, numbness or weakness precipitated by walking or prolonged standing and relieved by sitting, and lumbar flexion and forward bending.[5] Lumbar canal stenosis can be diagnosed by proper history physical examination and investigations such as radiographs and magnetic resonance imaging.

The various conservative treatment options include management with non steroidal anti-inflammatory drugs (NSAIDS), physical therapy, rest, epidural steroids, and root block injections. The surgical treatment includes posterior spinal decompression (PSD).[6] To measure NC, the NCOS was developed by Weiner et al.[7] As suggested, it is a simple, concise, self-administered outcome questionnaire and specifically tailored to address functionality in patients with NC. To analyze the functional outcomes of the decompressive surgery by JOAS was developed. Posterior spinal decompression has been reported as an effective procedure and associated with improvement of spinal claudication symptoms, low back and radicular pain in the patients with spinal stenosis.[8] On reviewing the literature we found that there is lacunae on studies to see the functional outcomes of PSD in Indian patients with NC due to lumbar canal stenosis whose expectations are different from other ethnic origin and to derive the functional outcomes basis on NCOS and JOAS.

[1–5]Department of Orthopedics, Rex Ortho Hospital, Coimbatore, Tamil Nadu, India

**Corresponding Author:** Vijaya Anand S, Department of Orthopedics, Rex Ortho Hospital, Coimbatore, Tamil Nadu, India, Phone: +91 9597474157, e-mail: drvijayanand24@gmail.com

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**Conflict of interest**: None

## Materials and Methods

It is a longitudinal prospective study done at Rex Ortho Hospital, Coimbatore, Tamil Nadu between June 2018 and May 2020 on 20 patients who had undergone PSD for lumbar canal stenosis, a written informed consent received from all the participants in the study with the following inclusion and exclusion criteria. All consecutive symptomatic patients with LSS confirmed by magnetic resonance imaging (MRI) and admitted for posterior lumbar spinal decompression (Tables 1 and 2).

A detailed evaluation of patient's symptoms and physical examination finding were done and documented. The severity of the patient's low back and leg pain was assessed and graded with the visual analog scale (VAS), while the preoperative functional status was evaluated with NCOS and JOAS.

### Neurogenic Claudication Outcome Score

It is a specific measure of functionality in patients with NC. It consists of eight questions with some questions containing items related to different functioning (questions 3 and 4), giving a total of 16 items for the questionnaire.

Each item is rated on a four-point scale with two-point intervals ranging from 0 to 6 (0–2–4–6) indicating worst to best conditions except for pain intensity where a 100 mm VAS is used. Patients select the point on the line that best represent his/her perception of pain intensity. The scale score then is calculated as the sum of all items ranging from 0 to 100 with higher scores indicating higher levels of functioning and/or better health status.

### Japanese Orthopedic Association Score

The JOA score was determined by direct questioning to assess subjective symptoms, clinical signs, and restriction of activities of daily living. The recovery rate of the patients following treatment was calculated by using the description of Hirabayashi et al. (1981).

Recovery rate (%) = (postoperative score – preoperative score)/(29 – preoperative score) × 100.

Recovery rate was classified using a four-grade scale: excellent, > 90%; good, 75–89%; fair, 50–74%; and poor, below 49%.

## Results

A total of 20 patients who had posterior decompression for lumbar canal stenosis were enrolled for the study. There were 12 females and 8 males, and the mean age of the participants is 68.05 years (SD = 5.09), the mean height being 162.75 cm (SD = 5.928), the mean weight of the participants is 66.08 kg (SD = 5.2). The mean duration of the symptoms is 22.6 months (Table 3).

The gender distribution showed a majority in the female pool than that of the males. This may be owed to the fact that lumbar canal stenosis is much more prevalent among the females in lieu of their hormonal, nutritional, and mechanical influences.

Majority of our patients (55%) had symptoms for 13–24 months and with a mean duration of symptom of 22 months.

**Table 1:** Exclusion criteria

| *Patients with spondylolysis* |
|---|
| Patients with instability |
| Patients with congenital spinal canal stenosis |
| Patients with deformity |
| Patients with double crush syndrome |
| Patients with cervical spine canal stenosis |
| Patients with discogenic lumbar canal stenosis |
| Patients with more than two levels of lumbar canal stenosis |
| Patients with uncontrolled diabetes and peripheral vascular disease |
| Patients with other cause peripheral neuropathy |

**Table 2:** Inclusion criteria

| *Patients with age ranging from 60–80 years* |
|---|
| Patients with clinical and radiological evidence of NC due to central canal stenosis |
| Patients with symptoms more than 6 months |
| Patients with failed conservative treatment |
| Patients with single level or two levels canal stenosis only |

Most of the patients had single level lumbar canal stenosis among that, we found 70% patients had at L4–5 level stenosis, 10% patient contributed to each level of L3–4 and L5–S1. A percentage of 90% of our patients had single level stenosis whereas 10% had two level stenosis. Among this isolated L4–5 was 14, isolated L3–4 was 2, and L5–S1 was 2. L3–4 and L4–5 was two patients (Fig. 1).

Neurogenic Claudication Outcome Score was assessed preoperatively and postoperatively at 3 months, 6 months, and 1 year. The mean NCOS at preop period was 30.25, at the time of 3 months postop was 45.1, at the time of 6 months postop was 56.1. At the end of 1 year NCOS in our study population was 66.65. The mean score was found to be increasing in every follow-up which is correlating with the clinical condition of our patients. The statistical test of NCOS at the different follow-up intervals was statistically significant ($p < 0.05$) (Table 4).

The claudication distance was measured preoperatively and postoperatively at the end of 1 year. Patients were classified into poor (less than 100 m), fair (100–800 m), good (800–1600 m), very good based on the walking distance. We found preoperatively 11 patients (55%) in the fair group, six patients (30%) in the poor group, and three patients (15%) in the good group. In postoperative period at the end of 1 year the claudication distance had increased significantly with 60% patients having very good claudication distance, 30% had good claudication distance, 2% patients had fair claudication distance, and none of our patients in the poor group (Figs 2 and 3).

Japanese Orthopedic Association Score was assessed preoperatively and post operatively at 3 months, 6 months, and 1 year. The mean JOAS at preop period was 10.90, at the time of 3 months postop was 24.35, and at the end of 1 year JOAS in our study population was 26.85. The mean score was found to be increasing in every follow-up which is correlating with the clinical condition of our patients (Table 5).

**Table 3:** Duration of symptoms

| *Duration of symptoms* | *Frequency* | *Percentage* |
|---|---|---|
| <12 months | 2 | 10 |
| 13–24 months | 11 | 55 |
| 25–36 months | 6 | 30 |
| 37–48 months | 1 | 5 |
| Total | 20 | 100 |

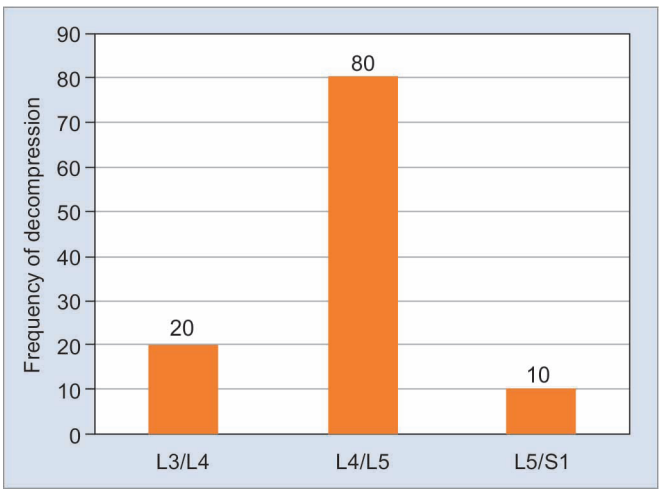



**Fig. 1:** Frequency of spinal levels

At 3 months follow-up 40% patients had fair outcome and 60% patients had good outcome and at the end of 1 year follow-up 75% patients had excellent outcome, 20% patients had good outcome, and 5% patients had fair outcome. The recovery rate has been noted to be increasing in the subsequent follow-up till 1 year and was sustained thereafter till the last follow-up. No patients had poor outcome (Table 6). Statistically significant improvement was seen in all variables except running and lifting heavy weight.

On comparison of preoperative and 3 months postoperative JOAS, *p*-value was <0.05 which is statistically significant. Further JOAS significantly improved even postoperatively till 1 year ($p < 0.05$). After 1 year, the JOAS did not change significantly with time till the last follow-up.

Pain assessment was done at time of surgery and after surgery. The mean score at the time of surgery was 6.8 and after surgery at the end 3 months was 3.7. The *p*-value for the statistical test for the difference in mean at this interval was <0.05 which was statistically significant.

Laminectomy was done in all patients, in combination with foraminotomy or discectomy in few patients as required depending on the components involved in the severity of stenosis. None of our patients had fusion as a part of procedure.

Most of the patients had single level decompression, two patients had two level decompressions at L3–4 and L4–5 (Fig. 4).

Preoperatively five patients had calcification, six patients had narrowed disc space, seven patients had spur formation, and no patients had instability based on plain and stress radiographs in our study. These parameters were not progressive in the subsequent follow-up for a period of 1 year. There were no significant

**Table 4:** Neurogenic Claudication Outcome Score at 3 months, 6 months, and 1 year

| | *N* | *Min* | *Max* | *Mean* | *Std. deviation* |
|---|---|---|---|---|---|
| NCOS (preop) | 20 | 8 | 47 | 30.25 | 7.840 |
| NCOS (postop) 3 months | 20 | 32 | 60 | 45.10 | 6.577 |
| 6 months | 20 | 40 | 72 | 56.15 | 8.002 |
| 1 year | 20 | 45 | 78 | 66.65 | 8.677 |

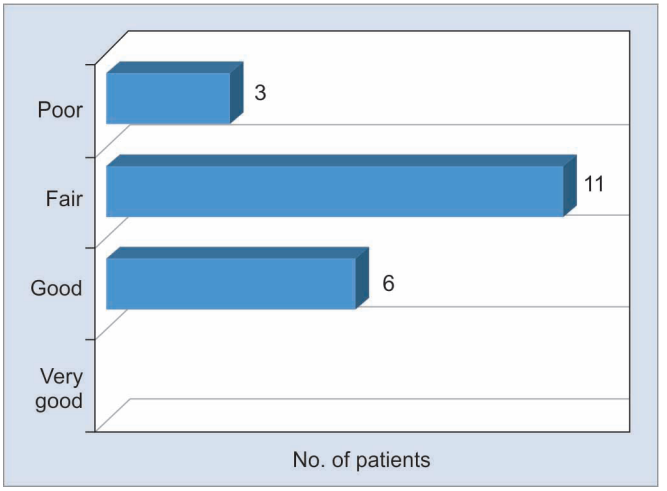



**Fig. 2:** Claudication distance—preop

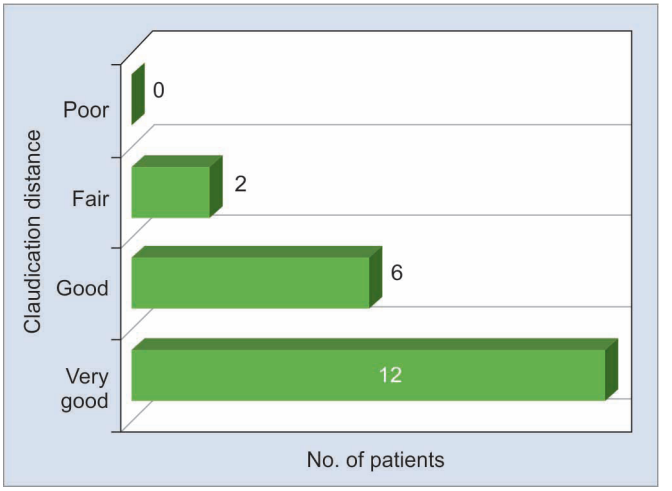



**Fig. 3:** Claudication distance—postop

**Table 5:** Japanese Orthopedic Association Score at preop, postop 3 months and 1 year

| | *Preop JOAS* | *Postop JOAS 3 months* | *Postop JOAS 1 year* |
|---|---|---|---|
| *N* | 10.90 | 24.35 | 26.85 |
| Mean | 20 | 20 | 20 |
| Std. deviation | 2.972 | 1.599 | 1.631 |

**Table 6:** Final outcome based on JOAS

| | *Outcome* | | | | |
|---|---|---|---|---|---|
| *Duration of follow-ups* | *Excellent (%)* | *Good (%)* | *Fair (%)* | *Poor (%)* | *Total* |
| 3 months | – | 12 (60%) | 8 (40%) | – | 20 |
| 6 months | 13 (65%) | 5 (25%) | 2 (10%) | – | 20 |
| 1 year | 15 (75%) | 4 (20%) | 1 (5%) | – | 20 |

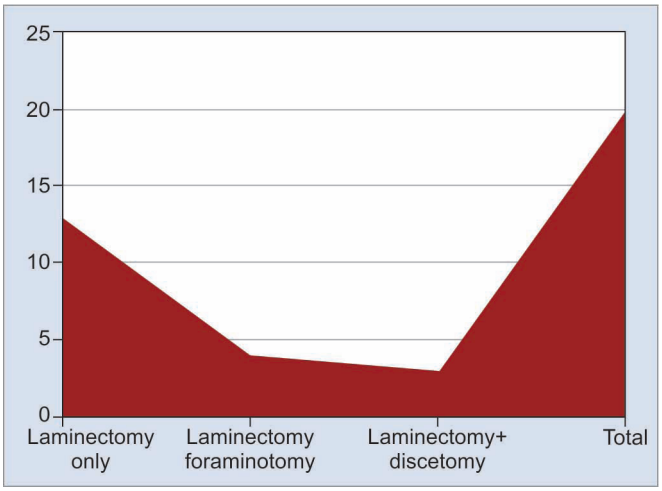
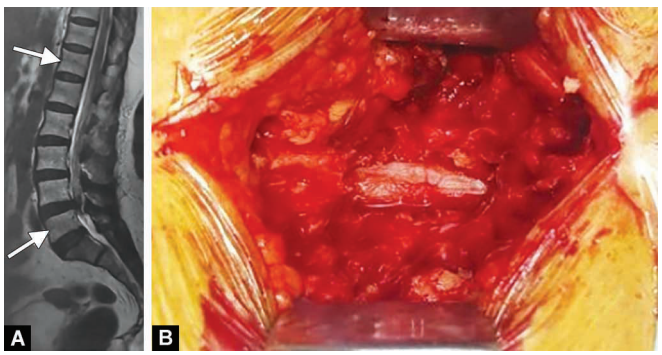



**Fig. 4:** Type of surgery




**Figs 5A and B:** (A) Preoperative T2 sagittal MRI of 63-year-old female patient showing degenerative lumbar canal stenosis (LCS) at L4–L5; (B) posterior decompression at L4–L5, preoperative NCOS was 34, at end of 1 year NCOS was 65

morphological changes in the follow-up X-rays depicting no progressive degeneration within that time. It might be too early to get the degenerative changes on the X-rays, further follow-up may be necessary to have the long-term findings. The decompression was adequate not causing instability as the facet joints were not disturbed.

## Conclusion

On reviewing the literature including a study by Hall et al. lumbar canal stenosis was noted to have a female preponderance. This female dominance was also noted in our study as 60% of our patients were females. In our study we had most of number patients belongs to the age group 60–65 years of around 45%. A percentage of 55% of our patients presented to us with back pain and NC at an average of 22 months. This is like the study by Muoghalu et al. which shows 35.9% of their patients had symptoms between 1 and 3 years.[10]

A percentage of 55% of patients belongs to fair group (100–800 m) on the basis of claudication distance, 30% patient fall into poor group (<100 m) preoperatively.

The mean preoperative VAS score in the patients was 6.80. This shows that the pain was moderate to severe in nature. This figure is slightly similar to the studies by Yukawa et al. and Gelalis et al. which was 7.1 and 7.5, respectively.[11] Also Sanderson et al. reported a preoperative pain score of 6.6 while Kwon et al. series preoperative mean VAS of 5.5.[12] Bojanic et al. had a preoperative pain mean score of 4 in their patients who underwent surgery for lumbar canal stenosis. The patient in our study had a delayed presentation after the onset of the symptoms with mean duration of symptoms of 22 months which is also supported by moderate to severe VAS score and fair claudication distance, due to advanced nature of the pathology causing late acceptance of surgical treatment.

The most common level found in our study was L4–L5 (70%). This agrees with pattern observed by Leonardi et al., which had L4–L5 as the most commonly decompressed level.[13] In the same manner Kwon et al. noted a similar pattern with a frequency of 79% for L4–L5 level. Next to this L3–L4 (20%) level pathology had most number of patients observed in our study; Kwon et al. had again reflected the same result as 39% due to L3–L4 in their study.

The mean preoperative NCOS found in our patients was 30.5 which is like the study by Rajasekaran et al. which was 26.32.[14] Amalan et al. in their study had mean NCOS of 27.60.[15] Also study by Azimi et al. 51 had preoperative mean NCOS of 26.30.[16]

This shows that patients had severe symptom of NC at the time of presentation. Also, this might be due to late presentation of the patient to the tertiary level care center.

In our study, 13 patients (65%) had only laminectomy as procedure during the decompressive surgery. The patients who had laminectomy only were those whose clinical presentation, radiological and intraoperative findings were suggestive of central canal stenosis from severely thickened ligamentum flavum with less significant lateral recess or foraminal stenosis.

Four patients (20%) in addition to laminectomy had foraminotomy which is like the study done by Postacchini et al.[17] Three patients (15%) had discectomy as a part of procedure along with laminectomy, in study by Postacchini et al.[18] 20% patients had discectomy, while Sanderson et al. in their study reported that none of their patients had discectomy as a part of procedure. Fusion was not a part of procedure in any of our patients. This is like the study by Sanderson et al.[12]

Two patients (10%) had two level decompression and 18 patients (90%) had single level decompression. The choice of level to be decompressed was made from both clinical and radiological findings. More than two level decompression were excluded as the modality of treatment may differ.

The study by Jonson et al. also submitted the number of patients who underwent single level decompression was more than the multilevel decompression.

Two patients underwent two level decompression who had preop NCOS of 8 and 33 and the NCOS were significantly raised to 48 and 64 at the end of 1 year, their claudication distance also increased from one level to another level, this again depicts that adequate decompression will be helpful for such patient when the selection is precise.

Pain assessment was done by VAS preoperatively and postoperatively. The mean preoperative VAS was 6.8 and the mean postoperative VAS at the end of 3 months was 3.7. The *p*-value for the statistical test for the difference in mean at this interval was <0.05 which was statistically significant and thereafter it remains same till 1 year of follow-up. This shows that decompression was adequate to relieve the symptoms and improve the functional activities of the patients. Claudication distance improved significantly in group of patients, 60% patients had very good claudication distance at the end of 1 year shows patients were doing well and we had no patients with poor claudication distance. Neurogenic claudication was assessed by NCOS at postoperatively at 3 months, 6 months, and at the end of 1 year, the mean was found to be 45.1, 56.1, and 66.65, respectively. The NCOS increasing

in subsequent follow-up shows that patient is doing well, and this is correlating with the clinical findings also with improvement in claudication distance. The statistical test of NCOS at the different follow-up intervals was statistically significant ($p < 0.05$). For understanding purpose empirically, we categorized the NCOS into four groups excellent (NCOS 60–80), good (NCOS 50–60), fair (NCOS 40–50), and poor (NCOS <40). While most of the patients, that is, 17 patients were doing well at end of 1 year with NCOS of more than 65. Two patients had NCOS of less than 60 in last follow-up with moderate disability due to uncontrolled diabetes. One patient had NCOS of less than 50 had deformity of the knee attributing to fair performance. None of the patients had score less than 40, that is, poor outcome. A percentage of 85% patients of our study had excellent outcome at end of 1 year based on NCOS and 75% had excellent outcome based on JOAS. This outcome is comparable to some previous studies on PSD for LSS. Postacchini et al. in their study reported that 81% of the patients had excellent outcome after spinal decompression surgery.[17] Also study by Nath et al. reported that 64% patient had excellent outcome at the end of 1 year following spinal decompression.[18] We had 10% patients who had good outcome at the end of 1 year following the PSD based on NCOS and JOAS.

None of our patients had poor outcomes. This indicates that selection of deserving patients and the decision of making the level to decompress was made by clinical and radiological assessment of the patient that was precise and reliable and the judgment by the senior spine consultant. Not to mention that all our patients had a late presentation with established symptoms with failed conservative treatment.

On seeing the radiological outcomes, none of our patient had instability in the postoperative period based on the stress view radiograph this also again signifies the decompression was adequate not causing the instability. One of our patients had delayed wound healing as a complication and this could be attributed to the history of uncontrolled diabetes. A study by Kanafani et al. reported 2.7% of their patients had delayed wound healing as complication and many of the infections occurred in diabetes.[19]

The PSD in patients with NC due to isolated lumbar canal stenosis of single or two level yields excellent results in 85% of patients in the age group of 60–80 years based on NCOS (85%, $n = 17$) and JOAS (75%, $n = 15$). All patients had significant reduction in low back pain and radicular pain with continuous improvement for a period of 1 year and thereafter it remains same.

Selection of patient is very important and careful assessment of other associated local or general problem may influence the outcome.

To conclude, patients with classical symptoms of lumbar canal stenosis with no instability and with proper selection criteria, single and/or double level PSD is bound to yield excellent to good functional outcome as shown in our study.

## Orcid

*Vijaya Anand S* https://orcid.org/0000-0002-3397-8377

## References

1. Katz JN, Dalgas M, Stucki G, et al. Diagnosis of lumbar spinal stenosis. Rheum Dis Clin N Am 1994;20(2):471–482. DOI: 10.1016/j.berh.2009.11.001
2. Niggemeyer O, Strauss JM, Schlitz KP. Comparison of surgical procedures for degenerative lumbar spinal stenosis: a meta-analysis of literature from 1975–1995. Eur Spine J 1997;6(6):423–429. DOI: 10.1007/BF01834073
3. Issack PS, Cunninghan ME, Pumberger M, et al. Degenerative lumbar stenosis: evaluation and management. J Am Acad Orthop Surg 2012;20(8):527–535. DOI: 10.5435/JAAOS-20-08-527
4. Patel CK, Truumees E. Spinal stenosis: pathophysiology, clinical diagnosis, and differential diagnosis. In: Herkowitz HN, Garfin SR, Eismont FJ, Bell GR, Balderston RA. Rothman–Simeone the Spine. Philadelphia: Elsevier Saunders; 2011. p. 1064–1077.
5. Suri P, Rainville J, Kalichman L, et al. Does this older adult with lower extremity pain have the clinical syndrome of lumbar spinal stenosis? JAMA 2010;304(23):2628–2636. DOI: 10.1001/jama.2010.1833
6. Antoniadis A, Ulrich N, Schmid S, et al. Decompression surgery for lumbar spinal canal stenosis in octogenarians; a single center experience of 121 consecutive patients. Br J Neurosurg 2016;31(1):67–71. DOI: 10.1080/02688697.2016.1233316
7. Weiner BK, Fraser RD, Peterson M. Spinous process osteotomies to facilitate lumbar decompressive surgery. Spine 1999;24(1):62–66. DOI: 10.1097/00007632-199901010-00015
8. Bae HW, Rajae SS, Kanim LE. Nationwide trends in the surgical management of lumbar spinal stenosis. Spine (Phila Pa 1976) 2013;38(11):916–926. DOI: 10.1097/BRS.0b013e3182833e7c
9. Hirabayashi K, Miyakawa J, Satomi K. Operative result and postoperative progression of ossification among patients with ossification of cervical p osterior longitudinalligament. Spine (Phila Pa 1976) 1981;6:354–64. DOI: 10.1097/00007632-198107000-00005
10. Muoghalu ON, Nwadinigwe CU, Iyidobi EC, et al. Early functional outcome of posterior spinal decompression for lumbar spinal stenosis at a Tertiary Health Institution, South East Nigeria. J Biosci Med 2018;6(7):1–14. DOI: 10.4236/jbm.2018.67001
11. Gelalis ID, Arnaoutoglou OC, Christoforou G, et al. Prospective analysis of surgical outcomes in patients undergoing decompressive laminectomy and posterior instrumentation for degenerative lumbar spinal stenosis. Acta Orthop Traumatol Turc 2010;44(3):235–240. DOI: 10.3944/AOTT.2010.2278
12. Sanderson PL, Wood PL. Surgery for lumbar spinal stenosis in old people. J Bone Joint Surg Br 1993;75(3):393–397. DOI: 10.1302/0301-620X.75B3.8496206
13. Leonardi MA, Zannetti M, Min K. Extent of decompression and incidence of postoperativeepidural haematoma among different techniques of spinal decompression in degenerative lumbar spinal stenosis. J Spinal Disord Tech 2013;26(8):407–414. DOI: 10.1097/BSD.0b013e31824a03eb
14. Rajasekaran S, Thomas A, Kanna R, et al. Lumbar spinous process splitting decompression provides equivalent outcomes to conventional midline decompression in degenerative lumbar canal stenosis. Spine 2013;38(20):1737–1743. DOI: 10.1097/brs.0b013e3182a056c1
15. Amalan RA, Nallakumar S, Devendran R, et al. Comparative study of functional outcome analysis and extent of paraspinal muscle damage between lumbar spinous process splitting decompression and conventional midline decompression for lumbar canal stenosis. Int J Sci Stud 2016;4(8):31–34. DOI: 10.1186/1471-2377-12-101
16. Azimi P, Mohammadi HR, Montazeri A. An outcome measure of functionality in patients with lumber spinal stenosis: a validation study of the Iranian version of Neurogenic Claudication Outcome Score (NCOS). BMC Neurol 2012;12:101. DOI: 10.1186/1471-2377-12-101
17. Postacchini F, Cinotti G. Bone growth after surgical decompression for lumbar spinal stenosis. J Bone Joint Surg Br 1992;74(6):862–869. DOI: 10.1302/0301-620X.74B6.1447247
18. Nath R, Middha S, Gupta AK, et al. Functional outcome of surgical management of degenerative lumbar canal stenosis. Indian J Orthop 2012;46(3):285–290. DOI: 10.4103/0019-5413.96380
19. Kanafani ZA, Dakdouki GK, El-Dbouni O, et al. Surgical site infections following spinal surgery at a tertiary care center in Lebanon: incidence, microbiology, and risk factors. Scand J Infect Dis 2006;38(8):589–592. DOI: 10.1080/00365540600606440