

Surgical Management of Lumbar Spinal Canal Stenosis with Instrumentation at the Yaounde Central Hospital: Comparison of Unilateral versus Bilateral Pedicle Screw Fixation Combined with Transforaminal Lumbar Interbody Fusion

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Abstract

Introduction: The choice of adopting unilateral pedicle screw fixation or using bilateral pedicle screw fixation in lumbar spinal stenosis remains controversial. In our context, very few studies have been performed comparing the clinical effectiveness of unilateral versus bilateral fixation in the surgical management of lumbar spinal canal stenosis. **Objective:** Evaluate the impact on quality of life and clinical efficacy of unilateral spondylodesis compared to bilateral spondylodesis in the surgical management of lumbar spinal canal stenosis at the Yaounde Central Hospital. **Methods:** This was a retrospective descriptive cross-sectional study for a period of 4 years, from June 2015 to June 2019. It involved all patients operated for lumbar canal stenosis and who underwent spondylodesis or spinal fusion at the neurosurgery department of the Yaounde Central Hospital. **Results:** A total of 68 participants were recruited during our study period. 32 (47%) of the study population were in the 50 - 60 age group, with a mean age of 56.98 years ranging from 41 to 75 years. Females, housewives and farmers were the most affected. In our study, 72% of patients had unilateral spondylodesis and 28% had bilateral fusion. Preoperatively, 71% of patients had insurmountable pain, refractory to medical treat-

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ment. At 3 months postoperatively, 73.7% of patients with bilateral setup had moderate pain compared to 69% of those with unilateral setup. At 6 months postoperatively, 79% of patients with bilateral fusion had mild pain compared to 82% of patients with unilateral setup. At 1 year postoperatively, all patients had mild pain. Preoperatively, 66.2% of patients were unable to walk and 19.1% of patients were bedridden according to the Oswestry score. At 3 months postoperatively, 10.2% of patients with unilateral setup were unable to walk compared to 10.5% of patients with bilateral fixation, while 67.3% of patients with unilateral fixation had moderate disability compared to 52.6% of patients with bilateral fixation. At 6 months postoperatively, 51% of patients with unilateral setup had moderate disability compared to 47.4% of patients with bilateral fixation, while 42.9% of patients with unilateral fixation had mild disability compared to 42.1% of patients with bilateral fixation. At 1 year postoperatively, 81.6% of patients who underwent unilateral fixation had only mild disability compared to 73.7% of patients with bilateral fixation. **Conclusion:** The assessment of quality of life according to the set-up used shows similar results at 3 months, 6 months and 1 year, with no statistically significant differences. Single-sided pedicle screw fixation combined with transforaminal lumbar interbody fusion or mounting has the advantage of being faster, with less bleeding and is less expensive compared to bilateral fixation.

Keywords

Lumbar Spinal Canal, Stenosis, Instrumentation, Surgery, Quality of Life

1. Introduction

Lumbar spinal canal stenosis is a pathology resulting from an anatomical impingement between the spinal canal (osteodisco-ligamentous sheath) and its contents (dural sac and roots of the cauda equina) at the lumbar level. It can be congenital or acquired, but it is most often acquired degenerative phenomena superimposed on a congenital narrow canal [1] [2]. Diagnosis is essentially clinical and the treatment of severe forms, which has a great impact on quality of life, is surgical. Work has been carried out in several African countries, notably Cameroon, on lumbar spinal canal stenosis and several aspects have been studied, including the epidemiological and surgical profile [3]-[8]. Spondylolysis is added as an adjunct to laminectomy when there is spinal instability or a secondary risk of instability. It is considered effective for certain degenerative disorders of the spine, such as spondylolisthesis, stenosis of the spine associated with deformities. Posterior lumbar interbody fusion has the benefits of no external immobilization, early ambulation, restoration of sagittal alignment and segment height, and improved fusion rate [9] [10] [11] [12]. However, segmental stiffness increases and mobility decreases after fusion [13]. Bilateral fixation in lumbar canal stenosis is a traditionally accepted method used in lumbar interbody fusion. This method offers both biomechanical and clinical benefits [14]. However,

due to the excessive rigidity of the system, internal fixation resulted in reduced bone mineral content [15] and degeneration of adjacent segments [1]. This led to the use of unilateral fixation aimed at decreasing the rigidity of the internal fixation. From the publication of the work of Kabins *et al.* [16], who performed lumbar fusion using unilateral fixation and reported favorable results in 1992, the clinical application of unilateral or bilateral fixation became a controversial issue. A series of studies have been conducted to evaluate the effectiveness of unilateral versus bilateral spondylodesis in lumbar spinal fusion, but there are still debates about which is better.

In our context, very few studies have been performed comparing the clinical efficacy of unilateral versus bilateral fixation in the surgical management of lumbar spinal canal stenosis. For us, it will be a question of evaluating the impact on the quality of life as well as the advantages and disadvantages of the 2 different fixation modalities.

2. Patients and Methods

This was a retrospective descriptive cross-sectional study conducted on all patients operated for lumbar canal stenosis and who underwent spondylodesis or fusion at the neurosurgery department of the Yaounde Central Hospital for a period of 4 years, from June 2015 to June 2019. After obtaining ethical clearance from the Ethics Evaluation Committee of the Faculty of Medicine and Biomedical Sciences of the University of Yaounde 1 and administrative authorization from the hierarchy of the Yaounde Central Hospital, we proceeded as follows: the initial step was to sort the files of all patients operated on for lumbar canal stenosis during the study period from the archives of the neurosurgery department. During this step, we checked on the surgical therapeutic modalities performed as well as the immediate and early post-operative follow-up. Subsequently, patients who met the study criteria were invited to the hospital for clinical examination and data was recorded on a pre-designed questionnaire. The information collected included the socio-demographic characteristics of the participants: age, sex, profession, place of residence, regions of origin, marital status. The preoperative clinical appearance: neurogenic claudication, low back pain, radiculalgia, cauda equina syndrome, motor and/or sensory deficit, pain intensity, Oswestry score. The surgical techniques used and the indications: laminectomy plus spondylodesis by unilateral or bilateral fixation. The intensity of the pain was evaluated using the visual analog scale (VAS). Oswestry Disability Index score [17] was used to assess the postoperative quality of life of the participants. A score of 0 to 20% was considered minimal disability, with patients carrying out their activities normally and no treatment was required. Counseling on hygienic measures alone is often enough. A score of 21 to 40% implies a moderate disability. Patients mainly feel pain after sitting, standing for a long time or when lifting a load. Travel and socio-professional life are particularly difficult. Personal care, sex life, sleep are not really disrupted. Conservative treatment is

sufficient here. A score of 41% to 60% involves severe disability. Pain remains the main problem, but activities of daily life are affected. A score of 61% to 80% implies an inability to walk. Lower back pain hinders all of the patient's activities. An intervention is essential. A score of 81% to 100% involves patients who are bedridden or who exaggerate their symptoms. The data collected was entered in a computer and analyzed using EPI Info version 3.5.4 and SPSS version 20. The variables studied were qualitative and quantitative and were represented in the form of averages and frequencies.

3. Results

3.1. Epidemiological Data

A total of 68 participants were recruited for this study. The majority of patients, 32 (47%) were aged 50 to 60 years. The mean age was 56.98 years with extremes being 41 to 75 years. Most participants (74%), were women. The occupations of the patients were as follows (**Table 1**).

Table 1. Distribution of patients according to their occupation.

Occupation	Total number (N = 68)	Percentage
House wife	25	36.76%
Farmer	20	29.41%
Civil servant	10	14.71%
Trader	8	11.76%
Retired	5	7.35%

3.2. Surgical Technique

In our study, 49 (72%) of patients had undergone unilateral spinal fixation or fusion using pedicle screws and rods while 19 (28%) had bilateral fixation (**Figure 1**).

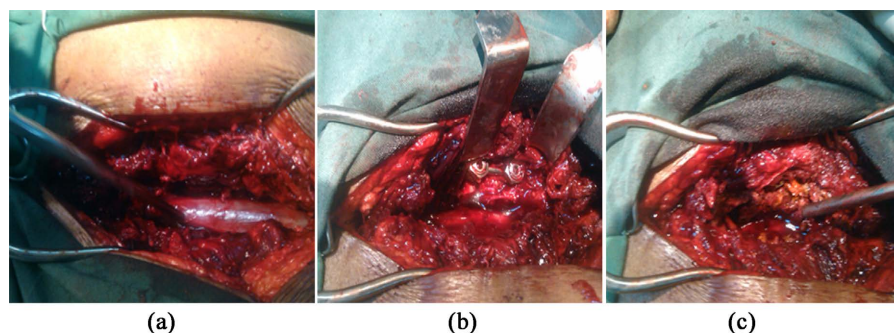


Figure 1. Surgical technique used. (a) Decompressed dural sheath after laminectomy; (b) Fixation material in place; (c) Posterolateral intertransverse bone graft.

3.3. Evaluation of Preoperative Quality of Life of Patients Using the Visual Analog Scale (VAS) and Oswestry's Disability Score

Pre-operative VAS (**Table 2**)

Table 2. Distribution of patients according to pre-operative VAS.

VAS	Total number (N = 68)	Percentage
[4 - 8[	20	29%
[8 - 10[	48	71%
Total	68	100%

Pre-operative Oswestry score (Table 3)**Table 3.** Distribution of patients according to pre-operative Oswestry score.

Pre-operative ODI	Total number (N = 68)	Percentage
]40 - 60]	10	14.7%
]60 - 80]	45	66.2%
]80 - 100]	13	19.1%
Total	68	100%

3.4. Comparative Evaluation of Postoperative Quality of Life at 3 Months, 6 Months and One Year after Surgery with Use of the Visual Analog Scale and Oswestry's Disability Score**VAS at 3 months after surgery (Table 4)****Table 4.** Distribution of patients according to VAS at 3 months after surgery.

VAS	Unilateral fixation		Bilateral fixation	
	Total number	Percentage	Total number	Percentage
[0 - 4[	15	31%	5	26.3%
[4 - 8[	34	69%	14	73.7%
Total	49	100%	19	100%

VAS at 6 months after surgery (Table 5)**Table 5.** Distribution of patients according to VAS at 6 months after surgery.

VAS	Unilateral fixation		Bilateral fixation	
	Total number	Percentage	Total number	Percentage
[0 - 4[	40	82%	15	79%
[4 - 8[	9	18%	4	21%
Total	49	100%	19	100%

VAS at 1 year post surgery (Table 6)**Table 6.** Distribution of patients according to VAS at 1 year post surgery.

VAS	Unilateral fixation		Bilateral fixation	
	Total number	Percentage	Total number	Percentage
[0 - 4[	49	100%	19	100%
Total	49	100%	19	100%

Summarizing VAS averages as a function of the fixation type used (Figure 2).

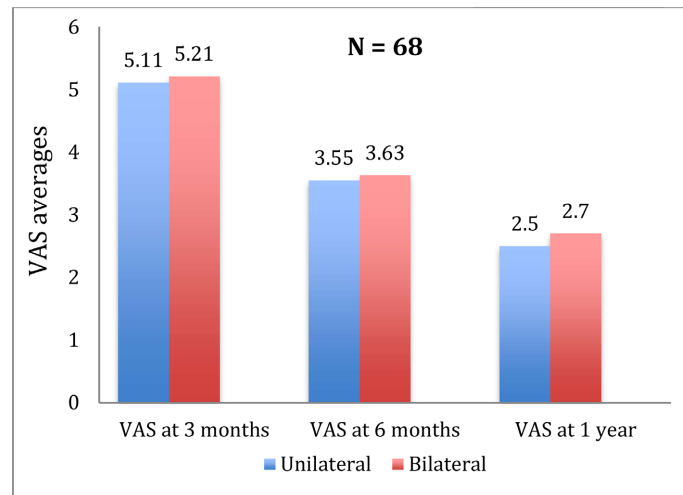


Figure 2. VAS averages expressed as a function of the fixation type used Post-operative Oswestry score.

Oswestry score at 3 months post-surgery

Table 7. Distribution of patients according to Oswestry score at 3 months post-surgery.

ODI at 3 mois	Unilateral fixation		Bilateral fixation	
	Total number	Percentage	Total number	Percentage
[0 - 20]	1	2.1%	2	10.5%
]20 - 40]	33	67.3%	10	52.6%
]40 - 60]	10	20.4%	5	26.4%
]60 - 80]	5	10.2%	2	10.5%
Total	49	100%	19	100%

At 3 months following surgery, 10.2% of patients who underwent unilateral fixation presented an inability to walk compared to 10.5% of patients who had bilateral fixation, while 67.3% of patients with unilateral fixation had a moderate disability compared to 52.6% of patients with bilateral fixation (Table 7).

Oswestry score at 6 months post-surgery

Table 8. Distribution of patients according to Oswestry score at 6 months post-surgery.

ODI at 6 months	Unilateral fixation		Bilateral fixation	
	Total number	Percentage	Total number	Percentage
[0 - 20]	21	42.9%	8	42.1%
]20 - 40]	25	51%	9	47.4%
]40 - 60]	3	6.1%	2	10.5%
Total	49	100%	19	100%

At 6 months post-surgery, 51% of patients who underwent unilateral fixation had moderate disability against 47.4% of patients with bilateral fixation, while 42.9% of patients with unilateral fixation had a mild disability against 42.1% of patients with bilateral fixation (**Table 8**).

Oswestry score at 1 year post-surgery

Table 9. Distribution of patients according to Oswestry score at 1 year post-surgery

ODI at 1 year	Unilateral fixation		Bilateral fixation	
	Total number	Percentage	Total number	Percentage
[0 - 20]	40	81.6%	14	73.7%
]20 - 40]	9	18.4%	4	21%
]40 - 60]	0	0	1	5.3%
Total	49	100%	19	100%

At 1 year following surgery, 81.6% of patients who had unilateral fixation presented only minimal disability compared to 73.7% of patients with bilateral fixation (**Table 9**).

Figure 3 below summarizes the average Oswestry scores as a function of the type of fixation used.

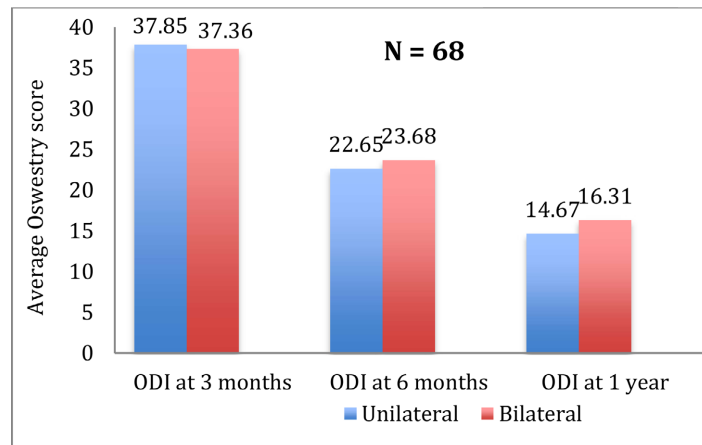


Figure 3. Summary of the average Oswestry scores based on the fixation type used.

4. Discussion

4.1. Epidemiological Data

The patients in our study were aged between 41 and 75 years, with a majority in the interval of 50 to 60 years (47%). The mean age was 56.98 years. These results are similar to those found in most series such as: Djientcheu *et al.* [3] in Cameroon with an average age of 57 years, Ngaroua *et al.* [4] with an average age of 59 years, Loembe *et al.* [6] in Gabon with an average age of 48 years, Kabre *et al.* [7] in Burkina Faso with an average age of 48 years, Iguchi *et al.* [18] in Japan found an average age of 60.9 years, Fokter *et al.* [19] in Slovenia, found an average age

of 66 years, Freyr *et al.* [20] found an average age of 71 years in Sweden, James *et al.* [21] got an average age of 66 years in the United States. We can see that the mean age of patients with lumbar spinal canal stenosis is higher in the Western population than in the African population. This can be explained by the fact that manual, rural work, more frequent in Africa contributes to the relatively early onset of lumbar spinal canal stenosis. The majority of patients operated on in our series were female with 74% women and 26% men. There is a clear large female predominance. In studies on the surgical aspects of lumbar spinal canal stenosis in general, Ngaroua *et al.*, Djientcheu *et al.* found a slightly lower female predominance of 2 to 3 women for 1 man [3] [4]. Likewise Loembe *et al.* in Gabon found a similar sex ratio [6]. Doo Sik *et al.* in Korea in a study on spinal fusion in lumbar spinal canal stenosis found a clear female predominance of 4 women for 1 man. The majority of patients operated on were housewives, farmers and civil servants. In addition, agriculture, domestic work and certain commercial activities involve the lumbar spine. This could explain the more rapid aging of the osteodiscoligamentous complex of the lumbar spine. Kabre *et al.*, Mvogo *et al.* and Djientcheu *et al.* came to the same conclusion [3] [7] [8]. Another explanation for the more rapid aging of the osteodiscoligamentous complex of the lumbar spine observed in Africans could be anatomical and biomechanical factors. The hyperlordosis of Africans, especially women could be implicated, as a result of increased mechanical constraints at this hinge zone [3].

4.2. Quality of Life Assessment

4.2.1. Based on Visual Analog Scale (VAS)

In our study, 71% of patients presented unbearable pain preoperatively, *i.e.* between 8 and 10 with an average VAS of 8.11. This pain dramatically altered the quality of life of patients and these results are similar to those found in a study conducted on 64 cases by Louis PK *et al.* [22] who found an average preoperative VAS at 7.7 ± 1.2 , and that obtained by Caralopoulos IL *et al.* in a study on lumbar spinal canal stenosis which found an average preoperative VAS of 8.6 ± 0.83 . Thus, the VAS represents a reliable tool for measuring pain as reported in most studies. At 3 months post-operatively, 69% of patients with unilateral fixation presented moderate pain with an average VAS of 5.11 compared to 71% of those with bilateral fixation with an average VAS of 5.2. At 6 months post-operatively, 82% of patients with unilateral fixation presented mild pain with an average VAS of 3.5 against 79% of patients with bilateral fixation and an average VAS of 3.6. These values are close to those of the study by Isik *et al.* [23] in Turkey who found an average VAS of 2.86 ± 0.65 for patients with unilateral fixation and 3.15 ± 0.76 for those with bilateral fixation. At 1 year post-operatively, 100% of patients in both groups presented mild pain with an average VAS of 2.5 for those with unilateral fixation and 2.7 for patients with bilateral fixation. These values are similar to those of the study by Isik *et al.* which found an average VAS of 2.19 ± 0.68 for patients with unilateral fixation and 2.39 ± 0.90 for those with a bilateral setup. The change in quality of life was favorable, patients passing from

severe pain to mild pain, and this regardless of the setup used, the differences found not being statistically significant.

4.2.2. Based on the Oswestry Score

In our study, 66.2% of patients were unable to walk with an ODI score between 60% and 80%, and 19.1% of patients were bedridden. The average score is 70.9%. These results are similar to those of the study conducted by Louis PK *et al.* which found an ODI of $72.4\% \pm 1.2\%$ and that of Haddadi K *et al.* [24] which found an ODI of 75.3%. At 3 months post-operatively, 67.3% of patients with unilateral fixation or setup had moderate disability against 52.6% of patients with bilateral setup. The ODI averages also decreased to 37.85% for patients with unilateral fixation and to 37.36% for patients with bilateral fixation. At 6 months post-operatively, the ODI averages improved to 22.65% for patients with a unilateral setup and to 23.68% for patients with a bilateral setup. These results are similar to those got by Soriano-Sanchez *et al.* [25] in Mexico who found an average ODI of $15.67\% \pm 8.35\%$ for patients with a unilateral setup and $9.92\% \pm 5.39\%$ for those with a bilateral setup. Isik HS *et al.* also found similar values, with an average ODI of $19.81\% \pm 2.82\%$ for unilateral fixation bearers and $20.30\% \pm 3.68\%$ for bilateral fixation carriers. At 1 year post-operatively, patients with unilateral fixation had mild disability in 81.6% and moderate disability in 18.4%. For patients with a bilateral setup, 73.7% had minimal disability, 21% moderate disability and 5.3% severe disability. The ODI averages were 14.67% and 16.31% for patients with a unilateral and bilateral setup respectively. These results are similar to those of the study by Soriano-Sanchez *et al.* which found an average of ODI of $11.5\% \pm 8.14\%$ for the bearers of a unilateral fixation and $9.82\% \pm 4.93\%$ for bearers of a bilateral fixation. Isik HS *et al.* also found similar values, with an average ODI of $14.82\% \pm 2.41\%$ for unilateral fixation bearers and $15.64\% \pm 3.10\%$ for bilateral fixation carriers.

In the neurosurgery department of the Yaounde Central Hospital, patients with lumbar spinal canal stenosis undergo spinal fusion in the presence of certain clinical, radiological and peroperative criteria.

- Clinically, mechanical type low back pain exacerbated by change in posture was the main criterion.
- Radiologically, spondylolisthesis and diastasis of the facet joints (isolated or associated with spondylolisthesis) represented our instability criteria.
- Intraoperatively, segmental hypermobility, consistent with the radiological level of instability, major arrectomy and associated disc herniation treatment constituted the main criteria for instability.

5. Conclusion

At the end of this work, it appears that lumbar spinal canal stenosis is a disabling pathology, found more frequently in the elderly. Women are more affected than men. The assessment of quality of life based on the setup used gave similar results at 3 months, 6 months and 1 year, with no statistically significant differ-

ence. The improvement in quality of life regardless of the setup used is maximum at 1 year. However, unilateral fixation has the advantage of being faster, less hemorrhagic and less expensive compared to bilateral fixation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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