Original Article

Outcome of Posterior Lumbar Interbody Fusion for Degenerative Lumbar Spine Spondylolisthesis in a Neurosurgical Centre in Nigeria

Chika Anele Ndubuisi[1,2], Wilfred Chukwuemeka Mezue[1,3], Francis Chukwuebuka Campbell[1], Okwuoma Okwunodulu[1], Ned Michael Ndafia[1], Amaka Martha Ozoagu[1,2], Samuel Chukwunonyerem Ohaegbulam[1]

[1]Department of Neurosurgery, Memfys Hospital, [2]Department of Surgery, Enugu State University of Science and Technology, [3]Department of Surgery, University of Nigeria, Enugu, Nigeria

Abstract

Introduction: Posterior lumbar interbody fusion (PLIF) is one of the options for the management of lumbar spine instability and is being increasingly used in Nigeria. The aim of the study is to assess the outcome of cases managed with PLIF in Enugu, Nigeria. **Methods:** Retrospective analysis of all patients that had PLIF for degenerative lumbar spine spondylolisthesis from the year 2016 to 2019 at a single centre the interbody fusion device was polyetheretherketone cage loaded with autologous bone graft. All patients presented with severe low back pain. Patients operated for traumatic spondylolisthesis and those managed with pedicle screw fixation alone were excluded. Patients were followed up for at least one year. The outcome was assessed using Japanese Orthopedic Association (JOA) scoring for back pain, visual analog score (VAS), fusion rate, and the 5-point patient-reported improvement scale. **Results:** A total of 57 patients were analyzed. The mean age was 56.5 ± 7.4 years and the mean duration of back pain was three years (1–15 years). The mean preoperative VAS was 7.9 ± 1.1, while the postoperative VAS score was 3.3 ± 1.7. The JOA scores before surgery and at least 12 months post-surgery were 12.9 ± 2.8 and 22.9 ± 4.9, respectively. The patient recovery rate was 63.3%. A satisfactory outcome was noted in 82.8% of patients, post-surgery. The average fusion rate postsurgery was 88%. The most common postoperative complication was cerebrospinal fluid leak (8.8%). Four obese patients had implant-related complications. **Conclusion:** PLIF for degenerative spine disease is associated with significant improvement in preoperative back pain and neurological outcome. It is also associated with good fusion, recovery, and patient-reported improvement.

Keywords: Degenerative lumbar disc disease, Nigeria, outcome, posterior lumbar interbody fusion, visual analogue score and Japanese Orthopedic Association

Introduction

The management options for patients with degenerative spondylolisthesis have evolved over the decades with variable results of the different options published globally.[1,2] Many options of instrumentation including stand-alone pedicle screw fixation and postero-lateral fusion have been described in the literature and are increasingly being used in Nigeria with the known limitations.[3] These limitations have led to the evolution of other advanced surgical options aimed at interbody fusion. Posterior lumbar interbody fusion (PLIF) is one of the interbody fusion-targeted options for the management of lumbar spine instability and is relatively new in Nigeria. Since Cloward,[2] performed the first procedure, the technique has undergone many modifications.[4,5] The rationale for PLIF is that fusion of the adjacent vertebral body segments should eliminate the instability of the affected spine segment in the long term. The aim of this study, therefore, is to assess the outcome and complication pattern of cases of degenerative lumbar spine instability managed with the surgical technique of PLIF in Enugu, Nigeria.

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Address for correspondence: Dr. Francis Chukwuebuka Campbell, Department of Neurosurgery, Memfys Hospital, KM 2 Enugu-Onitsha Expressway, P. O. Box: 2292, Enugu, Nigeria.
E-mail: drcampbellfrancis4@yahoo.com

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Methods

This is a retrospective analysis of all the patients that had PLIF surgery for degenerative lumbar spine spondylolisthesis from the year 2016 to 2019 at the study centre. A total of 57 patients aged between 39 and 70 years and with at least grade one lumbosacral spine spondylolisthesis were operated on consecutively during the study period. The interbody fusion device was a polyetheretherketone cage loaded with autologous bone graft. All patients presented to the clinic because of severe low back pain (LBP) with or without radiculopathy, neurogenic claudication or sphincter dysfunction. Surgery decision was made based on both the clinical and radiological evaluation of the patient. Patients had preoperative investigations with lumbar magnetic resonance imaging (MRI), computed tomography (CT) scan, and dynamic X-ray [Figure 1]. The decision for surgery was based on the age of the patient, the number of levels involved, degree of spondylolisthesis, the extent of bone destruction on the CT scan, extent of the associated canal, and exit foramen stenosis.

Patients operated for traumatic spondylolisthesis and those managed with pedicle screw fixation alone were excluded. Also excluded from the study were patients that had revision surgeries. The patients were followed up for at least one year after surgical intervention.

Following the decision to operate on the patients, adequate assessment for fitness for surgery was carried out including investigation for comorbidities, coagulation disorders, and infection screening with physician clearance obtained. All patients had at least two pints of blood grouped and cross-matched, informed consent obtained and anesthesia review before booking for surgery. Cervical spine MRI was requested for patients with upper motor neuron signs referable to the cervical spine to exclude advanced myelopathy that may cause iatrogenic cord injury during intubation or patient positioning.

Under general anesthesia and prone position, the back was scrubbed and draped using the standard protocol. All patients had classical laminectomy of the involved lumbar spine segments, ligamentum flavum excision, lateral recess decompression, and exit foraminotomy. Bone materials harvested during laminectomy were preserved for autologous graft. If needed, additional cancellous bone was harvested from the posterior iliac crest region.

Following decompression, a pair of lumbar pedicle screws were driven into the spine pedicles under C-arm guidance. Thereafter, a radical discectomy was done using serial shaving until adjacent endplates were optimally prepared for fusion. The disc space was distracted using the pedicle screws with the aim of achieving reduction where necessary and to allow impaction of the cage after insertion. The appropriate cage size for the disc was assessed using the templates. The harvested autologous bone materials were then tightly packed into the selected cage before the cage was carefully loaded into the disc space of interest under C-arm guidance. Finally, appropriately sized rods were used to connect the pedicle screws. Drains were used during wound closure in all cases. Patients commenced mobilization and physiotherapy within 24–48 h postsurgery except in cases of cerebrospinal fluid (CSF) leak.

Outcome at one-year postsurgery was assessed using the visual analog score (VAS), fusion rate, the 5-point patient-reported improvement scale[6] and Japanese Orthopedic Association (JOA) score for LBP JOA.[7] Fusion was defined as plain radiograph evidence of complete bridging at any point within the central area of the two adjacent vertebral bodies on follow-up plain radiograph. The recovery rate was calculated using the formula (Recovery rate of JOA

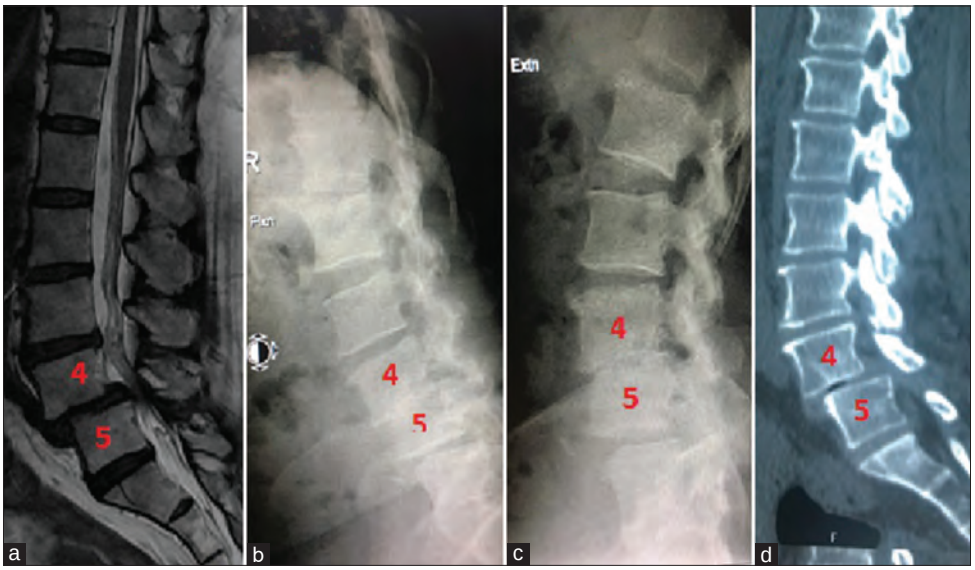

Figure 1: Preoperative imaging investigations for a patient with L4/5 spondylolisthesis. (a) (Magnetic resonance imaging), (b and c) (dynamic X-ray), (d) (computed tomography scan bone window)

score (%) = [Postoperative score − Preoperative score] × 100/[29 – Preoperative score]).[7] The progress of the patient postsurgery was monitored using clinical evaluation and follow-up lumbar radiographs. Data were analyzed using descriptive and inferential statistics using tables, mean, bar chart, *t*-test and aided by the SPSS version 17 (Chicago, Illinois, USA). A $P \leq 0.05$ was considered significant. Ethical approval was obtained for the study.

Results

The mean age was 56.5 ± 7.4 years and the male to female ratio was 2:3. The mean duration of back pain was 4.8 years and the mean hospital stay was one week. One-level fusion was done in 51 (89.5%) cases, two-level fusion was done in five (8.8%), while three-level fusion was done in one (1.7%) patient. A total of 63 levels were fused in the 57 patients that were operated on. The L4/5 level was involved in 39 (61.9%) cases, followed by L3/4 in 11 (17.4%), L5/S1 in 10 (15.9%), and L2/3 in 3 (4.8%). The common presenting symptoms were LBP (100%), radicular symptoms (82.5%), neurogenic claudication (77.2%), sphincter dysfunction (36.8%), and motor weakness (10.5%) [Table 1].

The mean preoperative VAS was 7.9 ± 1.1. Follow-up VAS postsurgery was 3.3 ± 1.7, $P = 0.0001$ [Table 2]. The mean JOA score before surgery was 12.9 ± 2.8. This improved to 22.9 ± 4.9 postsurgery, $P = 0.0001$ [Table 3]. The patient mean recovery rate was 63.3% while fusion was achieved in 88% of the patients. At one-year postsurgery, the 5-point patient-reported improvement scale revealed 5.7% (much worse), 8.6% (worse), 2.9% (neither worse nor better), 51.4% (better) and 31.4% (much better). Overall, 82.8% of the patients managed reported at least "better" satisfaction on the five-point scale [Figure 2]. The most common postoperative complication was CSF leak (8.8%) [Table 4].

Discussion

This study was considered necessary from the experience of the authors because, despite the high burden of degenerative spine disease and available manpower in spine surgery in Nigeria, there is still palpable reluctance among patients to undergo especially instrumented spine procedures. Unnecessary resources and time are chamnelled toward medical tourism, unguided physiotherapy, and analgesic abuse, which have potential side effects. These factors cause a delay in presentation to spine surgeons as observed in this study, where 36.8% of patients presented with sphincter dysfunction while the mean duration of back pain was three years.

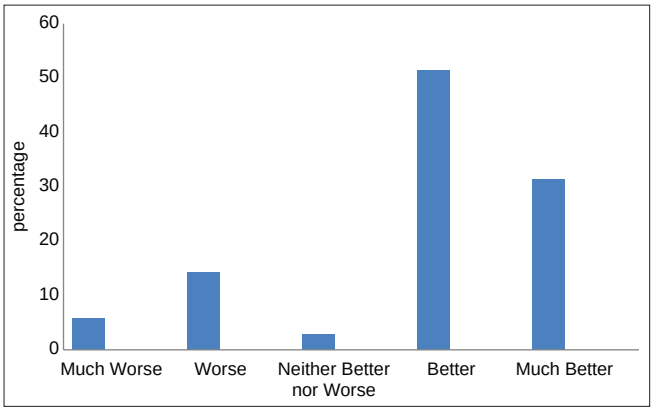

Figure 2: Patient-reported five-point improvement scale after posterior lumbar interbody fusion

Table 1: Basic information

Surgical characteristics	Mean (frequency, *n* (%))
Age (years)	56.5
Duration of LBP (years)	4.8
Blood need (points)	2
Hospital stay (days)	7.0
Clinical symptoms (*n*=57)	
Low back pain	57 (100)
Radicular symptoms	47 (82.5)
Neurogenic claudication	44 (77.2)
Sphincter dysfunction	21 (36.8)
Lower extremities weakness	6 (10.5)
Levels fused at surgery (*n*=63)	
L1/2	0
L2/3	3 (4.8)
L3/4	11 (17.4)
L4/5	39 (61.9)
L5/S1	10 (15.9)

LBP: Low back pain

Table 2: Comparison of presurgery and postsurgery mean pain outcome using visual analog score

VAS	Mean	SD	SE	*t*	*P*
Presurgery VAS	7.9	1.1	0.2	−11.2	0.000
Postsurgery VAS	3.3	1.7	0.3		

SD: Standard deviation, SE: Standard error, VAS: Visual analogue score

Table 3: Comparison of presurgery and postsurgery Japanese orthopedic association score

JOA	Mean	SD	SE	*t*	*P*
Preoperative JOA	12.9	2.8	0.5	11.1	0.000
Postoperative JOA	22.9	4.9	0.8		

SD: Standard deviation, SE: Standard error, JOA: Japanese orthopedic association

Table 4: Complications following posterior lumbar interbody fusion surgeries

Complication	Frequency, *n* (%)
Cerebrospinal fluid leak	5 (8.8)
Implant-related complication	4 (7.0)
Surgical site infection	2 (3.5)
Neurological deficit	2 (3.5)

PLIF: Posterior lumbar interbody fusion

Improvement in visual analogue score score

Disabling back pain is the most important clinical problem for patients requiring spinal surgery for degenerative disease and was the primary reason for instrumentation in this study. Pain severity correlates with the degree of disability and ability to sustain activities of daily living.[8] In this study, there was a significant reduction in pain intensity from a mean of 7.9 presurgery to 3.3 at one-year follow-up. This alludes to the effectiveness of PLIF and offers a chance for improvement in the quality of life of the affected patients. From this study, PLIF significantly improves VAS in the long term by helping to eliminate motion across the fused spine segments. The improvement in pain score in this study is attributed to meticulous decompression of the lateral recesses and exit foramina, which is often not achievable with transforaminal interbody fusion (TLIF).

Although disabling axial pain is the primary reason for instrumentation in this study, efforts should be made at the proper patient selection. It is essential to remember that LBP arises from a variety of causes and efforts must be made to establish the extent of contribution of instability to the patient's pain and exclude conditions such as osteoporosis. This is achieved by a high index of clinical suspicion aided by dynamic imaging and bone densitometry. Although the late presentation may explain the high preoperative VAS, the degree of improvement in VAS obtained in this study is comparable to other studies published in the literature worldwide.[9,10]

Improvement in Japanese Orthopedic Association score

JOA score is a measure of functional status in patients with severe back pain. This study observed a marked improvement in JOA following PLIF. In keeping with late presentation and significantly progressed degenerative disease at presentation, the preoperative JOA scores in the current study were quite low, a reflection of the extent of disability and activities of daily living before surgical intervention. Even with <50% spondylolisthesis presurgery, the majority of patients had severe back pain and poor functional status, probably a reflection of the effect of background congenital spinal canal stenosis.[9] The two-fold increase in JOA score observed postsurgery is an indicator of the impact of surgery in the management of advanced degenerative spine disease. The use of PLIF with pedicle screw fixation allowed more aggressive spinal canal and nerve roots decompression without undue fear of increasing spine instability. PLIF, in addition, adds the benefit of improvement in intervertebral disc height with a further freeing effect on the neural structures while improving the pain related to axial instability.[10] The outcome of JOA scores has been published by other studies in the literature.[7,11-16] Also, the average recovery rate in this study was 63%, which is considered by the authors as a good outcome when compared to another study[15] although the duration of follow-up were different.

Fusion rate

Similar to the finding of Aono *et al*.,[14] satisfactory fusion was achieved in 88% of the patients, which is promising for a medium-term follow-up period. The result of the fusion rate from the current study was different from reports from other studies that assessed fusion rates after a longer duration of follow-up.[17,18] However, it should be noted that some differences in the methodology of these studies may have explained these differences. Furthermore, most of the segments that had PLIF in this study were L4/5 to L5/S1 [Figure 3] which usually has lower fusion rates following PLIF.[14]

The authors believe that the inclusion of pedicle screws routinely contributed to the favorable outcomes since it helped to hold the construct in place temporarily, significantly reduced movement across the fused segments, and improved the chances of inter-body graft survival. It is therefore, recommended that in the absence of osteoporosis and where cost issues are not strong limitations, pedicle screw instrumentation should be offered along with PLIF in advanced degenerative spondylolisthesis.

Patient-reported improvement

Patient-reported outcomes brings out the patient's perception of the surgical outcome, not necessarily from the surgeons' viewpoint. The 5-point patient improvement scale[6] was used in this study and interestingly, the majority of the patients reported benefit from the PLIF procedure despite the presence of preoperative motor weakness, sphincter dysfunction, and long-standing disabling pain in a proportion of these patients. This result compares with the finding of another study in the literature.[6] Fujimori *et al*., also observed that the patient-reported outcome tends to agree with the improvement recorded in terms of JOA and the recovery rate.[6] The relatively advanced preoperative clinical condition of these patients may have also influenced patients' postoperative clinical improvement. It is therefore, rewarding to the surgeon that these patients experience significant improvement within one year of surgery.

Complications

The complication rate for PLIF varies in the literature with different percentages reported.[18-21] Six patients had various degrees of complications. The most common complication was intra-operative CSF leak observed in 8.8% of the

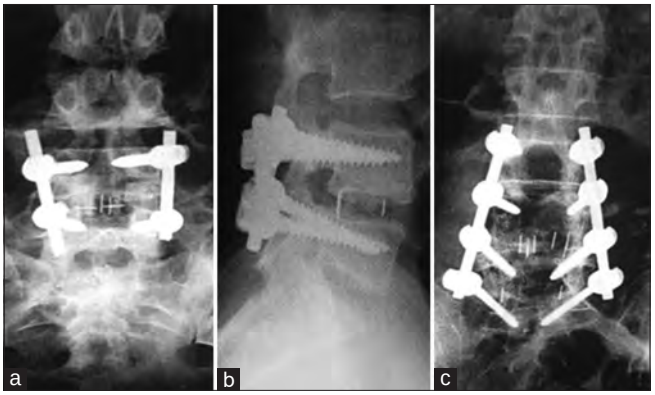

Figure 3: Postoperative plain radiograph of patients that had posterior lumbar interbody fusion. (a and b) (L4/5 fusion). (c) (L4/5 and L5/S1 fusion)

patients. This proportion of CSF leak is similar to findings from other studies.[20,21] All the cases complicated by CSF leak were managed with duroplasty intra-operatively with the enforcement of bed rest in the first few days, postsurgery. The more challenging complication was postoperative foot drop observed in two patients, which the authors believe was caused by aggressive distraction during reduction of spondylolisthesis. Both patients had >50% spondylolisthesis from preoperative dynamic imaging. One of the patients recovered completely while the second had residual weakness with the power of 3/5 and associated residual sphincter dysfunction. The lesson is to be careful with the enthusiasm of achieving complete reduction of spondylolisthesis at the expense of possible nerve injury in patients with advanced spondylolisthesis. In the literature, nerve root injury following PLIF has been reported.[18,21] TLIF has a much lower incidence of nerve injury and CSF leaks since its trajectory is more lateral.[22,23] There were four pedicle screw hardware-related complications of which three required revision. None of the implant complications was related to the PLIF cage used. Three of these implant-related complications were seen in obese patients and one of these patients had a fractured pedicle screw. This underscores the importance of body mass index assessment during patient selection especially in the study environment with many overweight patients presenting with spondylolisthesis.

Conclusion

PLIF for degenerative lumbar spine instability is associated with significant improvement in LBP as well as good neurological outcomes. The study also observed good recovery rate, patient-reported improvement, and radiological fusion rates following PLIF. CSF leakage is the most common complication. The current study suggests that PLIF is an effective technique in the management of degenerative lumbar spine instability.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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