ORIGINAL ARTICLE

Early results of two methods of posterior spinal stabilization in Nigerians

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Abstract

Background: In this study, early outcomes of the spinous process wiring with vertical strut (SPWVS) were compared with that of standard pedicle screw and rod (PSR) in our patients.

Materials and Methods: We obtained patients' bio-data, diagnosis, investigations, cost of implant, operative circumstances, complications, and outcomes from clinical documentation. Outcome measures, including postoperative infection and persistent/recurrent instabilities, implant related problems, operative blood loss and time and cost, were compared in the two groups of patients.

Results: Forty one (M:F-0.9:1) patients had PSR and 35 (M:F-2.2:1) had SPWVS. There was no difference in the occurrence of post-operative instability ($P = 0.630$), surgical site infection ($P \geq 0.416$), neurological deficits ($P \geq 0.461$) and implant related complications ($P \geq 0.461$) in the two groups of patients. Cost of implant in the PSR group range from N138,000 (for 2 level fusion) (1USD = N159) to N246,000 (for 4 level fusion) with an average of N192,000 (Standard deviation [SD] N44,090.81) depending on the number of level fused while the cost of implant for SPWVS was N8,000 irrespective of the number of level of fusion being carried out ($P = 0.000$). Mean estimated blood loss intra-operatively was higher for PSR (761.33 [SD 396.24] ml) than SPWVS (524.58 [SD 504.70] ml) ($P = 0.005$). Mean operation time was 397.17 (SD 122.183) min and 249.44 (SD 130.31) min PSR and SPWVS ($P = 0.000$).

Conclusion: SPWVS appears to be a good alternative to PSR, especially in our resource limited environment, in view of similar post-operative infection rate, implant complication, stability and post-operative neurological deterioration as well as shorter operation time, less estimated blood loss and much cheaper cost of implant in the former.

Key words: Fusion, outcome, pedicle screws, spinal wiring

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Introduction

The need for surgical stabilization skills for trauma, degenerative, neoplastic and infective spine conditions is becoming evident on a daily basis in our fast growing society. Surgical ward congestion, limited bed spaces and attending complications of prolonged hospitalization is making these procedures to be continually indispensable. Posterior stabilization with pedicle screw and rod (PSR) is popular in contemporary spine surgery.[1] It is favored over the older methods such as Harrington rod and sublaminar-wired Luque rod techniques because of its advantage of excellent fixation into the pedicle and vertebra body.[2] This leads to its ability to produce a biomechanically stiff construct with stability even with short spinal segment fixation.[2-4]

High-cost and inaccessibility of other instrumentations like PSR has made techniques like spinous process wiring with vertical strut (SPWVS) valuable options for our patients. SPWVS which was recently described by Adeolu *et al*. makes use of loops of wire passed through the base of the spinous

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process wire to secure two vertical L-shaped rods.[5] SPWVS works in a similar manner to long segment instrumentation like sublaminar-wired-Luque instrumentation.[6,7] However, complications of sublaminar wiring like canal compromise and potential risk of cord injury if the wire breaks or when it needs to be removed are not common with SPWVS.[8] Spinous process wiring, if carefully performed, rarely penetrates the spinolaminar junction.

SPWVS, as good as it appears, needs to be juxtaposed and evaluated against the widely practiced PSR in order to make a scientific conclusion. Our study was designed to compare clinical and radiological outcomes in our patients who underwent these two procedures.

Materials and Methods

This is a comparative study of clinical and radiological outcome of our patients who underwent SPWVS (from 2006) and PRS (from 2007) for posterior spinal stabilization until September 2012. The clinical records of these patients were reviewed up to date. The indication for both procedures was established or anticipated instability in patients with trauma, tumor, degenerative and infective spine conditions. Patients in the PSR group had standard technique for PSR insertion while the SPWVS had procedure described by Adeolu *et al*.[5] Patients were allocated to either of the two groups based on their preference, ability to afford the cost of implant, availability of implants and intraoperative X-ray monitor after extensive discussion with them and/or their relations.

Post-operative spinal stability was used as the primary outcome measure while secondary outcome measures include surgical site infection (SSI), new or worsening neurological deficit, cost of implant, operation time, blood loss, and post-operative mortality. These were subsequently compared for the two groups. New or worsening neurological deficit, back pain or spinal deformity was taken as signs of instability. SSI was defined as bacterial invasion of the tissue entered by the surgeon within 30 days of surgery or within 1 year if the implant is used. This was divided into superficial, deep and organ space SSI. In this study infection within a year was used as implant was involved. This definition has been added to the methodology.

Test of statistical significance was performed using the Chi-squared and Mann-Whitney U-tests with the level of significance set at less than 0.05.

Results

A total number of 76 patients had posterior stabilization with the two methods. Forty-one (M:F-0.9:1) patients had PSR and 35 (M: F-2.2:1) had SPWVS. Age range for the two procedures was 11-82 years and indications for surgery were trauma in 37, degenerative disease in 30, neoplastic conditions in 6 and infective conditions (tuberculosis) in 3 cases. This is shown in Table 1 and Figure 1.

SSI was superficial with 3 cases in the PSR group and 2 cases in the SPWVS. Deep SSI occured in one patient in the SPWVS group and 3 patients in the PSR group. Two patients had persistent instability in each of the groups ($P = 0.630$). Worsening neurological deficit occurred in one patient in the SPWVS group and none in the PSR group. One case of new neurologic deficit was also seen in PSR group with non in the SPWVS group. This is shown in Table 2.

Pattern of implant complications varies for the two procedures; screw fracture and imminent rod extrusion were only noticed in the PSR group with one case each ($P = 0.539$) while one case each of implant migration and backout were noticed in the SPWVS group ($P \geq 0.461$). Four mortalities were recorded in the PSR group while none was recorded in SPWVS ($P = 0.079$).

Cost of implant in the PSR group range from N138,000 (for 2 level fusion) to N246,000 (for 4 level fusion) with

Table 1: Characteristics of the study population

Patients charateristics	PSR	SPWVS
M:F	0.9:1	2.2:1
Total	41	35
Age range	11-82	26-77
Mean (SD)	49.34 (15.46)	49.54 (20.02)

PSR=Pedicle screws and rods; SPWVS=Spinous process wiring with vertical strut; SD=Standard deviation

Table 2: Comparison of infection rate, neurological deficit and implant complications in the two groups

Postoperative complications	PSR (%)	SPWVS (%)	*P* value
Instability			
Persistent instability	2 (4.9)	2 (5.7)	0.630
Infection rate			
Superficial SSI	4 (9.8)	2 (5.7)	0.416
Deep SSI	2 (4.9)	1 (2.9)	0.560
Neurological deficit			
New	1 (2.4)	0	0.539
Worsening	0	1 (2.9)	0.461
Implant complication			
Migration	0	1 (2.9)	0.712
Fracture	1 (2.4)	0	0.539
Backout	0	1 (2.9)	0.461
Bursa	0	1 (2.9)	0.461
Imminent rod extrusion	1 (2.4)	0	0.539

PSR=Pedicle screws and rods, SPWVS=Spinous process wiring with vertical strut, SSI=Surgical site infection

an average of N192,000 (SD N44,090.81) depending on the number of level fused while the cost of implant in the SPWVS group was N8,000 irrespective of the number of level of fusion being carried out. Mean estimated blood loss intra-operatively for PSR and SPWVS was 761.33 (SD 396.24) ml and 524.58 (SD 504.70) ml respectively while mean operation time was 397.17 (SD 122.183) min and 249.44 (SD 130.31) min respectively. The differences in these parameters were statistically significant (cost of implant [$P = 0.000$], intra-operative blood loss [$P = 0.005$] and operation time [$P = 0.000$]).

Post-operative radiograph of a patient in each group is shown in Figures 2 and 3.

Discussion

PSR has become the gold standard in posterior spinal fusion techniques. Its success has revolutionized spinal surgery. The Advantages include three column fusion as against one column fusion as is seen in other posterior fusion techniques like Rogers and Bohlman's techniques.[9-13] Other important advantages include the ability to fuse effectively with relatively short segments of the spine included in the fused region and prevention of rotational movement because it is far from the midline. These advantages are; however, challenged by its shortcoming, which may be quite significant in developing countries. These include

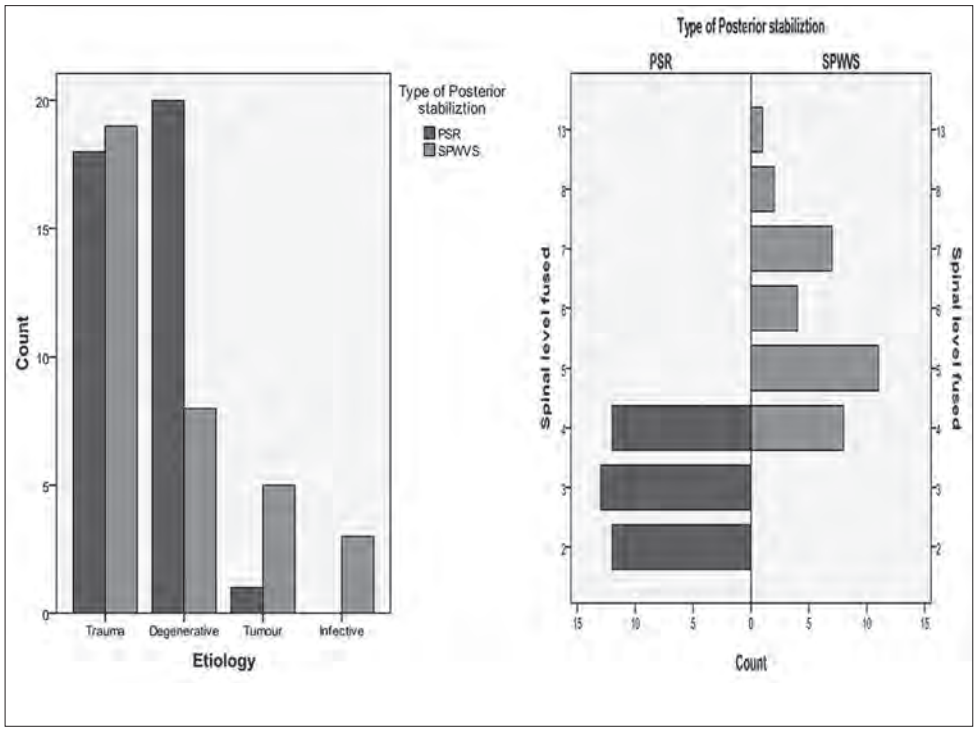

Figure 1: Characteristics of the study population

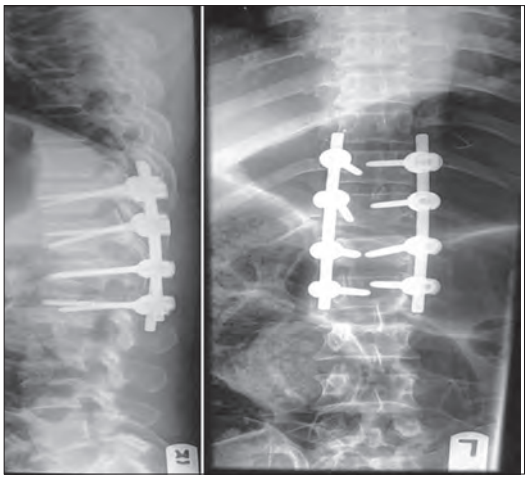

Figure 2: 36-year-old man who had fusion with pedicle screw and rod

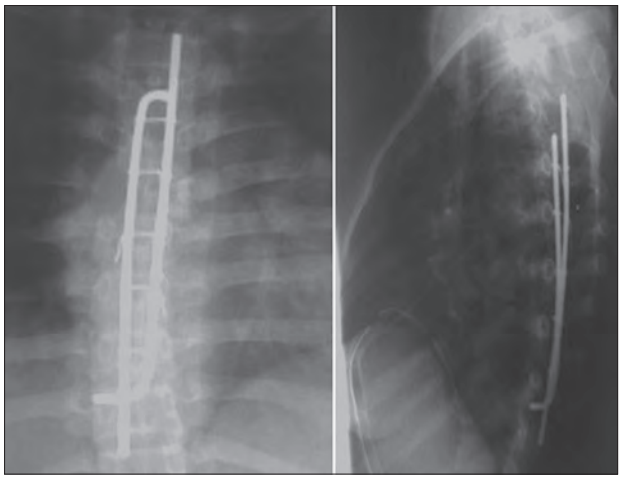

Figure 3: Spinous process wiring with vertical strut

availability and cost of the implants, expertise to insert the screws, availability of instruments and the need for intra-operative X-rays fluoroscopy. The consideration for these challenges is particularly important in resource poor countries like Nigeria.

Our study shows similarities in the rate of postoperative instabilities and other complications especially, wound infection this rate also compares with values obtained in other studies on posterior spinal fusion techniques. However, cost of implants, duration of surgery and intraoperative blood loss are in favor of SPWVS.

Exposure for spinal wiring entails the standard exposure for laminectomy. However, we usually do extensive dissection, especially post-erolaterally, to expose for our pedicle screw insertions. This may explain the long duration for PSR as well as blood loss. Perhaps, if other methods of pedicle screw fusion like use of percutaneous fusion or posterior lumbar interbody fusion are employed, the difference in surgery time and blood loss will be less. The effect of a learning curve for the operating team is also important; we noticed a decrease in the operation time when the team gradually got accustomed to the technique and the instrumentation. The need for intraoperative image intensifier is a major challenge for PSR, and this is a limitation for its use, thus, making SPWVS very suitable in any standard operation room. This is of particular advantage in developing countries where image intensifier may not be easily available.

The least spinal levels fused with SPWVS technique is four as against two for PSR. In addition, PSR was used to achieve a reduction of deformity and displacement; the SPWVS cannot be used to achieve this in its present development. Thus, only patients with minimal or acceptable vertebral displacement had the procedure in the series. This is a major advantage for PSR, though the impact of this in the study was not objectively evaluated.

SPWVS share similarities with some previously described techniques like Rogers wiring, Bohlman, Drummond as well as Luque sublaminar wiring techniques.[9,11,13,14] Its closeness to the midline limits its ability to prevent rotational motion. This will account for the failure in maintaining stability in one of the patients. The patient had corpectomy for T4 hemangioma. She subsequently had posterior stabilization with Rush Nail and sipnous wire. She developed neurological deterioration following mobilization with dislodgment of the graft. She thereafter did well after redo-thoracotomy with application of external orthotics. The other case of recurrent instability in the study occurred in a patient who had partial corpectomy and stabilization for T4 Pott's disease. Following surgery, she had a fracture of some spinous processes with imminent extrusion of the implants, worsening deformity and pain. She is the only one with this complication in this study. It probably occurred because of small immature spinous processes; the patient was the youngest in the series. Extending the instrumented level higher than two segments above and below the lesion and application of external orthotics would have prevented the complication. The aforementioned will explain why the causes of instability in these two patients are unlikely to recur in our series in view of the better understanding of the technique.

The risk of accidental canal penetration could occur with above techniques, and in fact, is one of the reasons for abandoning some of them.[8] However, we did not observe this in any of the patients who had SPWVS using routine post-operative X-ray.

An important limitation of this study is the poor follow-up because many of the patients were lost to follow after 6 months of surgery. The outcome measures used were mainly immediate and early post-operative parameters. Long-term measures especially rate of bony union and long-term complications like wire fatigue and fractures remain to be determined.

Another significant limitation of this study is the lack of ethical approval for the work. A further explanation on how the spinous wiring and vertical strut started will help to illustrate its peculiarity; we started work in 2006 in a patient in whom we had planned to do sublaminar wiring with rush nail as vertical strut. This procedure had been largely abandoned in developed countries in view of the reasons earlier mentioned.[8] However, because the patient had spinal instability and PSR were not available in the country at the time, he was counseled for the procedure. Adequate information was given to the patient on the technique, but it proved technically difficult to perform sublaminar wiring at surgery, and we elected to hold the vertical strut by passing the wires through the spinous processes. Thus, the procedure was started as a necessity to solve a challenging problem. We subsequently had other patients with spinal instability necessitating stronger constructs and they all had the technique with modifications to improve its safety and effectiveness.[5] We started using PSR in late 2007. We have been keeping a record of the cases from the onset, and this study is the report on the early outcome of the two techniques. Efforts are already in place to further perform biomechanical test on the work and to evaluate the long term outcome. This definitely will involve a more planned work with ethical approval.

Conclusion

This study has shown that patients who underwent SPWVS had similar outcomes in terms of post-operative infection rate, implant complication, stability and postoperative neurological deterioration compare to those who had PSR.

Operation time, estimated blood loss and cost of implant were significantly higher in the PSR group. Thus, SPWVS appears to be a good alternative to PSR especially in our resource limited environment.

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