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Pitfalls of Transpedicular Screws in Non-traumatic Lumbar Spondylolisthesis

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Abstract

Background: Spinal fusion and instrumentations are performed in a wide spectrum of spinal disorders including trauma, infections, degenerative deformities and spinal tumors. The application of pedicular screws is often associated with some complications which may be related to the misuse of the device, the surgeon's skills and/or directly related to the screws themselves.

Aim of the work: was to analyze different types of complications in 240 patients with transpedicular screw and rod fixation for non-traumatic lumbar spondylolithesis with follow up period up to three years.

Methods: This retrospective study included 240 patients (160 females and 80 males with F: M ratio 2:1) with age group between 30 to 65 years old (mean age was 47.5) who underwent transpedicular screws and rod fixation for non-traumatic lumbar spondylilthesis in Al-Menoufia University Hospitals between May 2008 and April 2011.

Results: There were 20 patients (8.3%) developed different complications among 240 patients included in the study with higher incidence in males (12 cases of 80 patients) than in females (8 cases among 160 patients).

The most frequent complications reported in our study were related to insufficient surgical skills in 7 cases (35%) that lead to malposition of screws and/or permanent root injury.

Other complications include implant related complications in 6 cases (30%), adjacent level disease in 4 cases (20%) and general complications in 3 cases (15%).

Conclusion: Pedicular screw fixation significantly improved the outcome of spinal reconstruction, but it may be associated with some potential complications which include medical complications, hardware complications and long-term changes of motion segments.

Keywords: Spinal fusion; Transpedicular screws; Complications

Introduction

Surgery for spinal fusion and instrumentation is performed for a wide spectrum of indications, including trauma, infections, degenerative deformities, tumors and correction of congenital anomalies such as scoliosis. The ultimate aim of spinal fusion is to restore anatomic alignment and functional biomechanics to as near normal as possible [1]. Internal fixation devices can preserve alignment and prevent motion to optimize graft incorporation. Commonly used methods include long rods with pedicular screws, lateral mass screws and sublaminar hooks. Pedicular screws have become the preferred method of reconstruction when multiple-column reconstruction is required [2].

After King's placed first transfacet screws in 1944, there had been rapid development resulting in improvements in Screw placement techniques Design of screws and plates Bone -graft techniques [3].

The use of pedicular screws is often associated with some complications which may be related to the misuse of the device, the surgeon's skills or directly related to the screws themselves [4].

In spite of the widespread use of pedicular screws, there are only few studies on problems, complications and outcomes in this group of patients. These complications may be attributed to many factors including:

I) Patient-related factors

Either anatomical or medical such as:

A) Anatomical variations: Morphometric studies of the pedicle have demonstrated variations in pedicle shape, size and angulation which may interfere with placement of screws [5].

B) Osteoporosis: may prevent adequate screw placement and may necessitate the use of PMMA augmented screws [6].

II) Implant-related factors

Faulty design or manufacture can lead to stress effects and early failure of the system [7].

III) Technique-related factors

Poor fixation could be the results of inadequate surgical techniques such as placing the screw outside the pedicle, fracturing the pedicle and/or placing improper size or length of the screw [8].

Aim of the work

The aim of this study was to analyze different types of complications in patients with transpedicular screw and rod fixation for non-traumatic lumbar sponylolithesis with follow-up period up to three years.

Patients and Methods

A) Patient population

This retrospective study included 240 patients (160 females and

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80 males with F: M ratio 2:1) with age group between 30 to 65 years old (mean age was 47.5) who underwent transpedicular screws and rod fixation for non-traumatic lumbar spondylilthesis in Al-Menoufia University Hospitals between May 2008 and April 2011.

Inclusion criteria

1- Persistent LBP and/or sciatic pain for more than 3 months.

2- No response to medical treatment for 6 weeks.

3- Radiological tools (X-ray, CT scan and MRI) confirmed diagnosis

Exclusion criteria

1- History of recent back trauma.

2- Previous spinal surgery.

3- Medically unfit patient.

After fulfill inclusion criteria, all patients included in the study had Plain AP and lateral flexion extension radiographs. CT and MRI of lumbo-sacral spine were used to confirm diagnosis.

B) Follow-up

Radiological follow-up was done at 3, 6 and 12 month intervals by plain X-ray. CT lumbo-sacral spine was done at the end of the study to confirm the fusion.

The criteria for fusion:

1- Development of continuous bony bridging.

2- No motion in the flexion-extension radiographs [9].

C) Post-operative complications

I) Implant-related problems: Those related to screws themselves such as fracture, bending or pulling out of the instrument.

II) Fused segment-related problems: Such as pseudoarthrosis, disc space narrowing or loss of reduction in the instrumented segment.

III) Adjacent level-related problems: Due to excessive loading that may result in adjacent level spinal canal stenosis, instability or kyphosis at the adjacent level.

IV) General complications: Due to medical disorders (Figures 1-6).

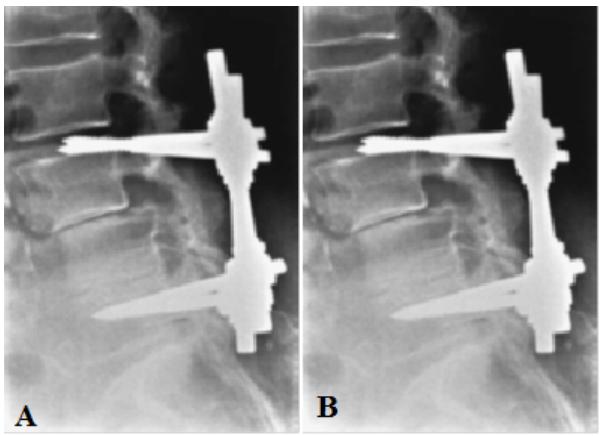

Figure 1: A) Post-operative plain X-ray showed false placement of screws into the upper end plate. B) Post-operative CT showing both screws are converging into the spinal canal.

Figure 2: Post-operative plain X-ray showed breakage of both sacral screws.

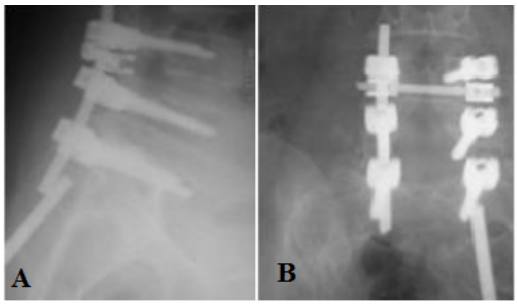

Figure 3: Post-operative plain X-ray (A. Lateral & B. AP) showing distal rod dislodgement.

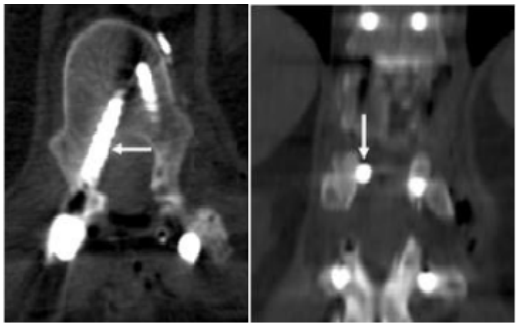

Figure 4: Post-operative CT (axial and coronal view) Showed medical deviation of the screw with penetration of the dural sac.

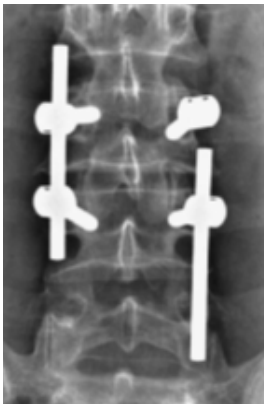

Figure 5: Post-operative plain X-ray showed loosing of the left rod due to improper tightening of the blocking elements.

Figure 6: Post-operative plain X-ray showed narrowing of the adjacent disc space.

Levels of fusion	No.	%
Single level	130	54
Double level	70	29
Multilevel	40	17
Total	240	100

Table 1: Pre-operative levels of fusion among the studied group.

Incidence of complications	No.	%	P-Value
Single level	3	15	P<0.001
Double level	5	25	
Multilevel	12	60	
Total	20	100	

Table 2: Incidence of complications among the studied group.

Complications	No.	%
Surgical Skills complications	7	35
Implant related complications	6	30
Adjacent level complications	4	20
General complications	3	15
Total	20	100

Table 3: Post-operative overall complications among the studied group.

Complications	No.	%
Breakage of the screws	2	28
Malposition of the screws	3	44
Dislodgement of the rods	2	28
Total	**7**	100

Table 4: Implant-related complications among the studied group.

Complications	No.	%
Loss of reduction	3	50
Disc space narrowing	2	34
Pseudoarthrosis	1	16
Total	6	100

Table 5: Instrumented level-related complications.

Complications	No.	%
Narrowing of the adjacent level	3	75
Pesudoarthrosis of the adjacent level	1	25
Total	4	100

Table 6: Adjacent level-related complications.

Complications	No.	%
Post-operative pseudomeningocele	1	34
Post-operative spondylodiscitis	2	66
Total	3	100

Table 7: General complications.

Results

Results are given in the Tables 1-7.

Discussion

Pedicular screws fixation facilitated segmental fusion in a wide variety of spinal disorders ranging from congenital malformations to spinal neoplasms with good predictive outcome [10].

The advantages of transpedicular screw and rod fixation are well established including achievement of reduction and fixation, stability of fixation which allows early mobilization of the patient and lock of only short segment of the spine [11].

Despite the increasing popularity of screw-plate systems for pedicle fixation in patients having spinal arthrodesis, we are not aware of any long-term follow-up studies. There have been several reports of use of fixation devices for arthrodesis of the lumbosacral spine and in 1949, Straub et al. mentioned eighty operations that Wilson had done in 1943 [12].

The current short study is based on a retrospective review of 240 patients who had spinal fixation with a screw-plate and rod system for nontraumatic lumbar spondylolithesis and were followed for at least one year postoperative.

Among the studied group, 20 patients (9%) developed post-operative complications either related to the device system or related to the procedure itself and this was a lower rate of complications in comparison to West et al. who reported 26 - 29% complicated cases; most of those were minor complications [13].

In our short study, the higher incidence of post-operative complications was encountered among patients with multilevel spinal fusion (60%) and this correlates with the results of Cook et al. who reported 63% complication rate among patients with multilevel spinal fixation [14].

Hardware complications reported in our study were screw misplacement (44%) and failure of the device (28%) and could be due to insufficient experience and this correlated with the results of Yuan et al. who reported a higher rate of instrument failure (38%-46%) in his series on 280 patients with nontraumatic spinal disorders and he concluded that well-trained spine surgeons are mandatory for performing such procedures [15].

Other complications reported in our study such as fatigue fracture and loosening of the screw (28%) could be due to micro-movement at the region of the screw and rod and/or osteoporosis which was reported in about 43% of patients.

The complications reported in the only few studied dealing with the outcomes of transpedicular screw and rod fixation were similar to or slightly higher than reported in our short study. Among these studies, one study included 51 patients who had spinal fusion showed a complication rate of 57% of patients who developed adjacent level syndrome and this is in contrast to our study that showed a higher incidence (75%) of narrowing of the adjacent level [16].

The radiological assessment of fusion is imperfect and there is no optimal method of diagnosing nonunion, so, nonunion cannot be considered as a device-related complication.

In similar previous studies, there was no correlation between solid bony fusion and clinical outcome and this correlated with the results reported in our study [17].

In contrast with other studies, spinal infection was not a major

cause of complication in our study as only 2 cases developed post-operative discitis and both were treated conservatively with good outcome at the end of the study [18].

Conclusion

Transpedicular screws and rod fixations are effective method in treating various spinal disorders but it may be associated with some potential complications as previously described.

According to the results reported in our study, we believe that most of complications after fusion surgery are related to lack of surgical knowledge regarding surgical skills, instrument design and details of spinal anatomy. In other words, we can think that well-trained spine surgeons, detailed knowledge of pedicle anatomy, the outline use of image intensification during screw placement and proper selection of patients and system are mandatory for good surgical outcome [4].

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