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Management of Complications of Posterior Lumber Spine Fixation for Spondylolithesis

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Abstract

BACKGROUND: Posterior lumbar spine fixation surgery is a very common practiced procedure for the management of wide range of spinal pathologies, with advances of surgical approaches and the evolution of new techniques. Post-operative complications, however, are common.

AIM: This study aims at identifying the varieties, causes, treatment, and prevention of postoperative lumbar instrumental fixation complications.

METHODS: A prospective study was carried out on 50 complicated cases out of 350 operative lumbar spine fixations, without stratification on bases of sex or age, excluding the patients with known chronic debilitating diseases.

RESULTS: Obesity is a risk factor for the pathogenesis of spondylolisthesis in general, regardless the age or sex, where the mean body mass index was above 30. The most affected levels are L4-5, and L5-S1 with a significant dominance of back pain as a presenting complaint, while neurological deficits were rare. The most common etiologies were isthmic lythesis followed by spondylolisthesis respectively. The most common finding requiring further management was failed prosthesis and adjacent segment failure. Other less frequent findings were Sacroiliac dysfunction, posterior cage migration, screw malpositioning, infection, dural tear, cerebrospinal fluid leak, pseudarthrosis, and one patient with pseudo-meningocele. Thirty-two patients (64%) were managed surgically, while the other 18 patients (36%) were managed conservatively with improvement in 40 patients, while 10 cases did not improve.

CONCLUSIONS: With postoperative complications in lumbar fixation surgery, surgical management should be always considered with a good outcome. However, it should be emphasized that our results were limited by the small sample size. Further prospective randomized studies should be carried out, and a meta-analysis is recommended.

Introduction

Lumbar spine fixation surgery is practiced commonly for a wide spectrum of pathologies such as traumatic fractures, pathological fractures, degenerative diseases, and others. With the advances in new technologies, new techniques have evolved such as kyphoplasty and vertebroplasty using fenestrated screws, lumbar interbody fusion with various approaches, or anterior approaches for anterior corpectomy, and others. Yet, the complications are still unavoidable. Some complications can be managed conservatively with an improvement of the patient's symptoms, while others may affect the quality of life and need another surgical intervention. In our present study, we aim at identifying the varieties, causes, treatment and prevention of post lumbar instrumental fixation complications, which was conducted on a study population of 50 cases.

Patients and Methods

This is a prospective study of complicated 50 cases out of 350 operative lumbar spine fixations which were surgically managed in the neurosurgery department at Cairo University and Ministry of health hospitals from January 2016 to December 2019. We include older than 30 years and younger than 60 presenting with symptomatic lumbar spondylolisthesis and failed routine conservative treatment, operated upon by fixation with a presenting complication. Cases with debilitating chronic diseases were excluded.

The procedure is done under general anesthesia in prone position on a radiolucent table. Careful positioning of the limbs to avoid nerve entrapment and careful padding of the pressure areas of the body are insured. Intra-operative blood loss was estimated. Post-operative pain score on a 10-point visual analog scale was assessed before discharge, 3–6 months post-operatively.

The radiological outcome used was fusion rate after 6 months of the operation. We judged the fusion in the form of solid construct without change in the dynamic plain radiographs, absent system failure, or pseudoarthrosis in the form of black hallows around the screws and lucency around the interbody allograft.

Complications were assessed clinically and radiologically and strictly monitored and categorized as either major or minor complications. The major complications group include allograft malposition that requires reoperation, new or increased neurological deficit that lasts more than 3 months and notwithstanding substantial conservative treatment, infection, pedicle screw malposition that required a patient readmission to the hospital. Minor complications group included allograft or screw malposition that did not require reoperation, cerebrospinal fluid (CSF) leak, and transient neurological deficit less than 3 months that was effectively treated conservatively including physical therapy and/or steroid injection.

Results

The series included 50 cases suffering from post-operative complications, 17 (34%) were males and 33 (66 %) were females. The age ranged from 30 to 60 years with a mean age of 45.9 ± 9.9 years in the study population. The mean body mass index (BMI) in the study population was 31.6 with Standard deviation SD of ± 3.1, calculated as (BMI = weight kg/(height m^2), for all cases of study. Most patients had only one level affected, 21 patient L4/5 level (42%), and 22 patients at L5/S1 level (44%), only seven patients presented with double level L4/5- L5/S1 (14%) (Figure 1).

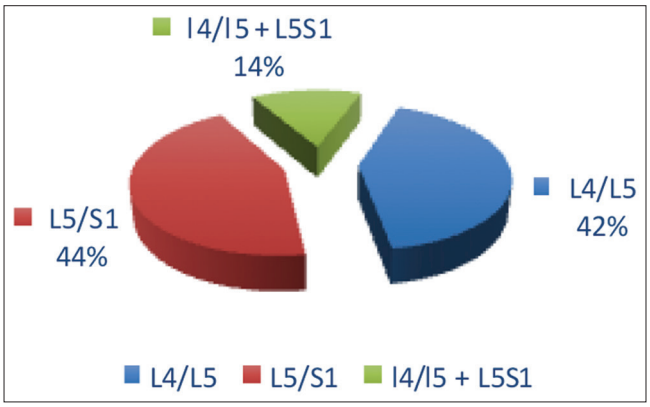

Figure 1: Spinal levels distribution

In our study, back pain and neurogenic claudication were the most common presenting symptoms with back pain occurring in all patients (100%) followed by neurogenic claudication occurring in 22 patients (44%). The least presenting symptom was the sciatica which occurred in nine patients (18%). Only 6 patients (12%) had palpable step on examination of their back. While 11 patients presented with sensory deficit prior to surgery (22%), Sphincteric disturbance and motor neurologic deficit did not occur in any of the cases (Table 1).

Table 1: Clinical presentation among study population

Clinical finding	n = 50	
	n	%
Back pain	50	100
Claudication pain	22	44
Sciatica	9	18
Sensory deficit	11	22
Palpable step	6	12

The most common etiology in our study population was isthmic lythesis in 37 patients (74%), Spondylolisthesis in eight patients (16%), disc prolapse in 4 patients (8%), and only one patient with degenerative lumbar scoliosis (2%) (Table 2).

Table 2: Etiology of spinal instability

Etiology	n = 50	
	n	%
Isthmic lythesis	37	74
Spondylolisthesis	8	16
Disc prolapse	4	8
Lumbar scoliosis	1	2

Among the studied cases, 17 patients (34%) were operated upon by fixation with decompression, while 11 patients (22%) were operated by fixation with TLIF, 8 patients (16%) were operated by fixation and discectomy, 5 patients (10%) were operated with TLIF and extended decompressive laminectomy, 4 patients (8%) were operated by fixation without step reduction, 3 patients (6%) were operated by TLIF only, one patient (2%) was operated upon by fixation with PLIF and one patient (2%) was operated upon by fixation with correction of the lumbar curve (Table 3).

Table 3: Surgical intervention

Operation	n = 50	
	n	%
Fixation with decompression	17	34
Fixation with TLIF	11	22
Fixation and discectomy	8	16
TLIF with decompression	5	10
Fixation without step reduction	4	8
TLIF only	3	6
Fixation with PLIF	1	2
Fixation with correction of the lumbar curve	1	2

Among the studied cases, 39 patients (78%) were fixed at one level, 9 patients (18%) were fixed at two levels, one patient (2%) was fixed at 3 levels and one patient (2%) was fixed at four levels (Table 4).

Table 4: Number of fixed levels

Levels	n = 50	
	n	%
Single level	39	78
Double levels	9	18
Three levels	1	2
Four levels	1	2

Among the studied 50 cases with post-operative complications, the complaints varied as follows:

Twenty-nine patients (58%) were complaining from low back pain, 12 patients (24%) were complaining of Sciatica, 4 patients (8%) were complaining of Sacroiliac pain, 3 patients (6%) were complaining of

claudication pain and 2 patients (4%) were complaining of wound discharge, while the numbers above detail the main complaint of each patient, most patients had more than one complaint, comprising a combination of the above (Table 5).

Table 5: Post-operative complaints

Complaint	n = 50	
	n	%
Low back pain	29	58
Sciatica	12	24
Sacro-iliac pain	4	8
Neurogenic claudication	3	6
Wound discharge	2	4

Among the studied 50 cases with post-operative complications, the following findings are described:

In 9 patients (18%) we found broken screws 6 months post-operative, 5 patients (10%) posterior cage migration, 4 patients (8%) we found screw malpostioning, in 4 patient (8%) infection, 3 patient (6%) Dural tear, 2 patients (4%) CSF leak, one patient (2%) with pseudo-meningocele, 6 patients (12%) with Sacroiliac dysfunction, in 9 patients (18%) adjacent segment failure and in 7 patients (14%) we found pseudarthrosis (Table 6).

Table 6: Post-operative findings

Finding	n = 50	
	n	%
Broken instrumentation	9	18
Posterior cage migration	5	10
Screw malpostioning	4	8
Infection	4	8
Dural tear	3	6
CSF leak	2	4
pseudo-meningocele	1	2
Sacroiliac dysfunction	6	12
Adjacent segment failure	9	18
Pseudarthrosis	7	14

In all the cases, a diagnosis of the complication was made by clinical examination and radiological examination, the positive finding however depended upon the complication nature, of the 50 cases studied, and 25 cases (50%) were diagnosed by magnetic resonance imaging (MRI) scan, 11 cases (22%) by clinical exam, and 14 (28%) cases by computed tomography (CT) scan (Figure 2).

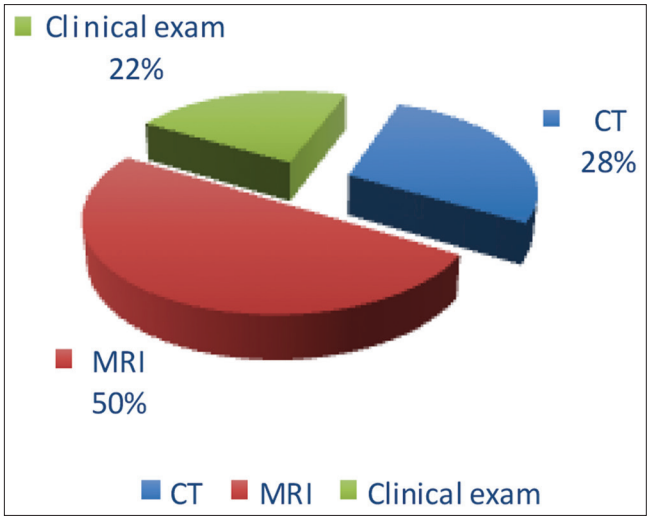

Figure 2: Diagnosis main modality

Out of the 50 cases studied, 32 patients (64%) were managed surgically, while the other 18 patients (36%) were managed conservatively. Out of the 32 patients treated surgically, ten cases were operated upon by extension of fixation (31.2%), 6 patients were operated upon by correction of mal-positioned screws (18.75%), cage removal done in 5 cases (15.62%), while the rest of cases (11 patients) representing 34.37% of the 32 cases operated, underwent various procedures, namely, debridement for four cases with infection with prosthesis removal, and repair for CSF leak in two cases, with extended decompression and foraminotomy in five cases (Table 7).

Table 7: Modalities of surgical management of complications

Surgery	n = 32	
	n	%
Extension of fixation	10	31.25
Correction of screw position	6	18.75
Cage removal	5	15.62
Debridement	4	12.5
CSF leak repair	2	6.25
Decompression	5	15.62

After managing the post-operative complications surgically and conservatively, and following up the patients for a period of 6 months, 40 patients (80%) improved, and 10 patients (20%) not improved.

The improvement was measured according to the complication at hand, either pain improvement in cases of symptomatic complications. Or the resolution of a surgical complications such as infections and CSF leaks.

Out of the ten cases that did not improve, 4 patients (8%) of total, had a complaint of persistent sacroiliac pain, all of whom were treated conservatively, 4 patients (8%) with persistent low back pain, three of which were treated surgically, namely, by extension of fixation due to failed adjacent segment, one treated conservatively, and 2 cases (4%) complained of persistent sciatica, treated conservatively due to absence of surgical indication (Table 8).

Table 8: Cases that failed to improve

Complaint	n = 10	
	n	% of non-improved cases
Sacro-iliac pain	4	40
Low back pain	4	40
Sciatica	2	20

Case No I

A 54-year-old female patient was diagnosed with L3-L4 spondylolisthesis and operated upon by L3-L4 fixation. Two years post-operatively she complained of severe low back pain. Imaging was done upon complication showing L2-3 and L4-L5 levels failure with stenosis and degenerative scoliosis (Figures 3-5).

She was operated upon by extension of the fixation from L2 to S1, with lumbar canal augmentation

and bilateral foraminotomy, and deformity correction (Figure 6).

Figure 3: AP/Lateral X-ray after first operation

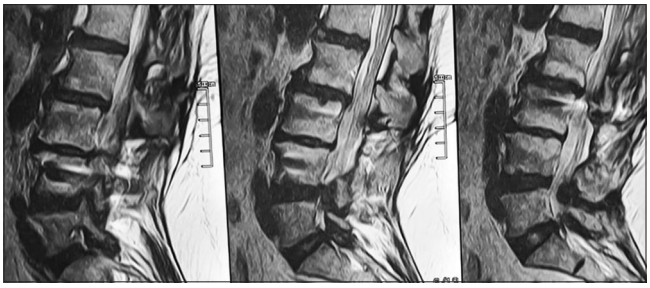

Figure 4: Magnetic resonance imaging T2 WI in sagittal view

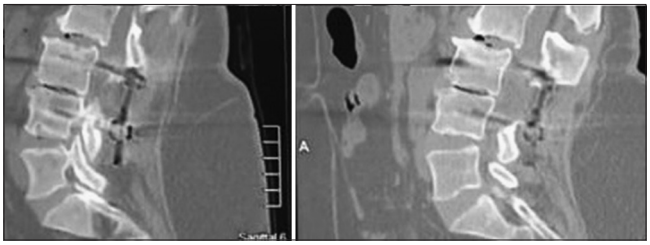

Figure 5: Computed tomography LSS in sagittal view

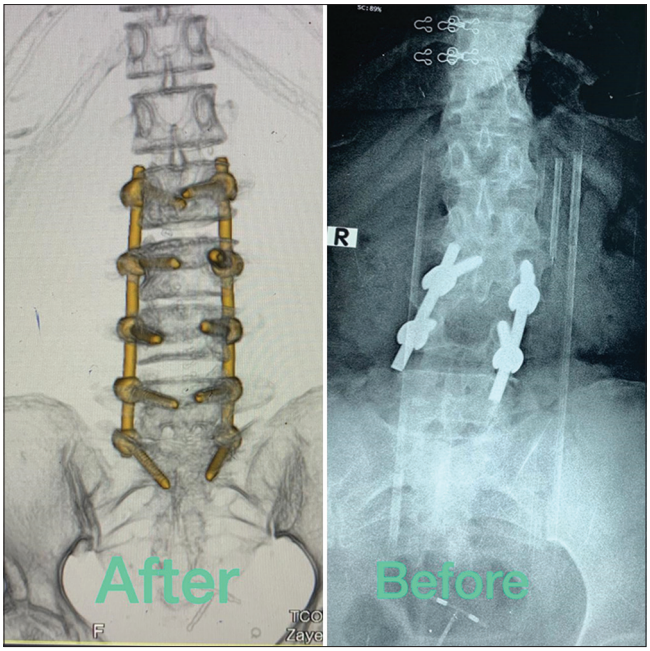

Figure 6: Post correction comparison

Case No II

A 36-year-old female patient, with a history of L2 fracture and operated upon by short segment fixation L1-L3, postoperatively she presented complaining of low back pain which worsened in the last 6 months, associated with bilateral lower limb pain. MRI CT and X-rays showed broken screws and screw cap and rod with kyphotic deformity (Figures 7 and 8).

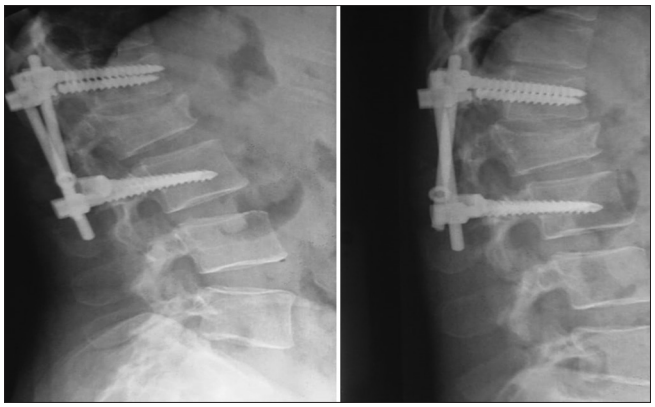

Figure 7: X-ray LSS dynamics

She was operated upon by extension of fixation D12 to L3 involving L2, along with deformity correction (Figures 9 and 10).

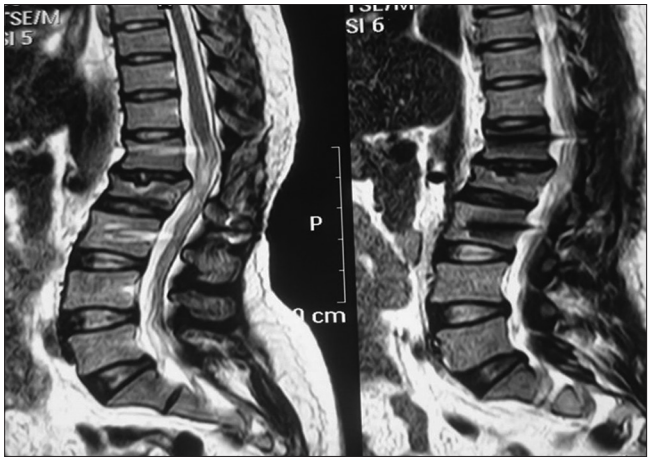

Figure 8: Magnetic resonance imaging T2 WI in sagittal view

Case No III

A 52-year-old male patient, presented with a complaint of gradual onset and progressive course of low back pain for 1 year and 2 months associated with left lower limb pain on movement from a sitting position. The patient was operated upon by L4, L5 discectomy, and cage placement with fixation L4-L5-S1. The patient developed severe back pain 4 months later. MRI, CT, and x-rays were done showing cage migration and prosthesis displacement (Figures 11-13).

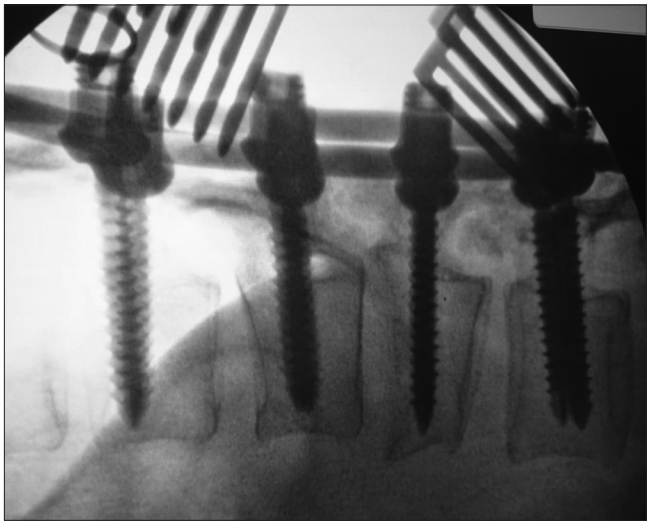

Figure 9: Intra-operative fluoroscopy

Figure 10: Post-operative X-ray 6 months follow up

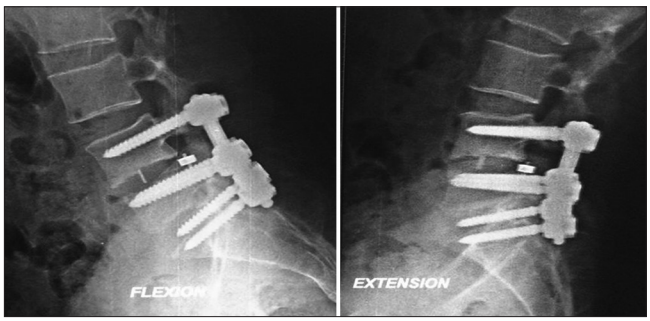

Figure 11: Dynamic X-ray LSS AP/lateral views

The patient was operated upon for revision of the prosthesis and replacement of a larger cage with foraminotomy bilaterally (Figures 14 and 15).

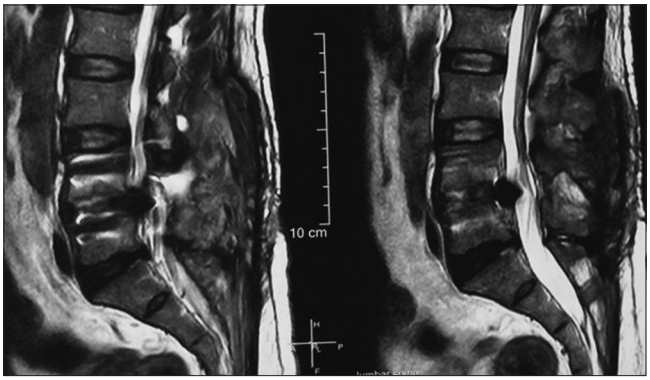

Figure 12: Magnetic resonance imaging T2 WI sagittal view

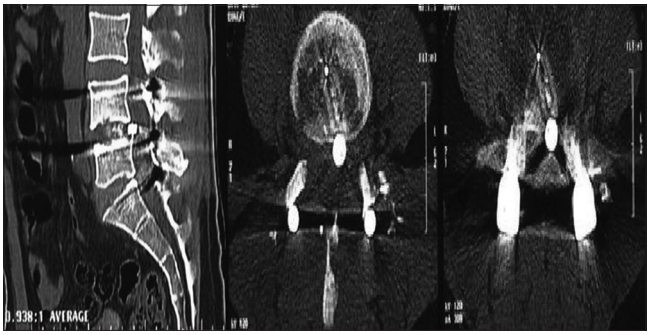

Figure 13: Computed tomography sagittal and axial views

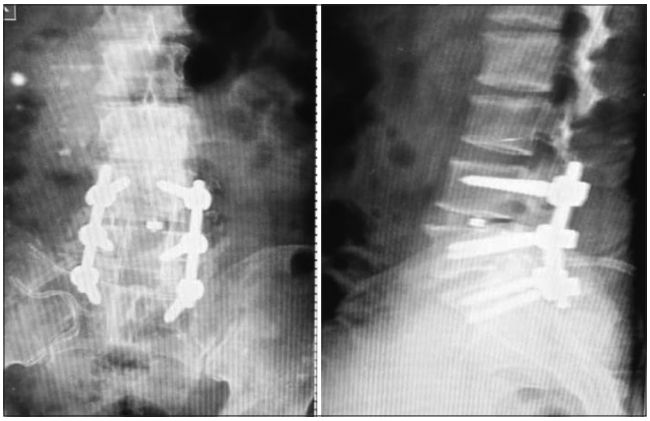

Figure 14: Post-operative X-ray LSS AP/Lateral views

Figure 15: Post-operative computed tomography scan, Bone window, sagittal view

Case No IV

A 55 years old female patient, complaining of gradual onset and progressive course of low back pain for 2 years. Imaging showed spondylolisthesis at level L5S1, she was operated upon by L5-S1 fixation. She presented 6 months later with low back pain with a flexion attitude in standing. MRI and X-ray dynamics showed instability and post-fixation Pseudoarthrosis (Figure 16).

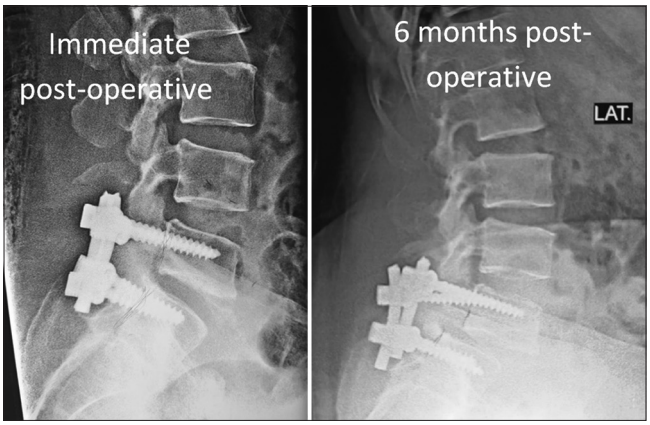

Figure 16: Complication development – lateral view X-rays

She was operated upon by extension of fixation from L3 to S1, with foraminotomy and reduction of the spine (Figures 17 and 18).

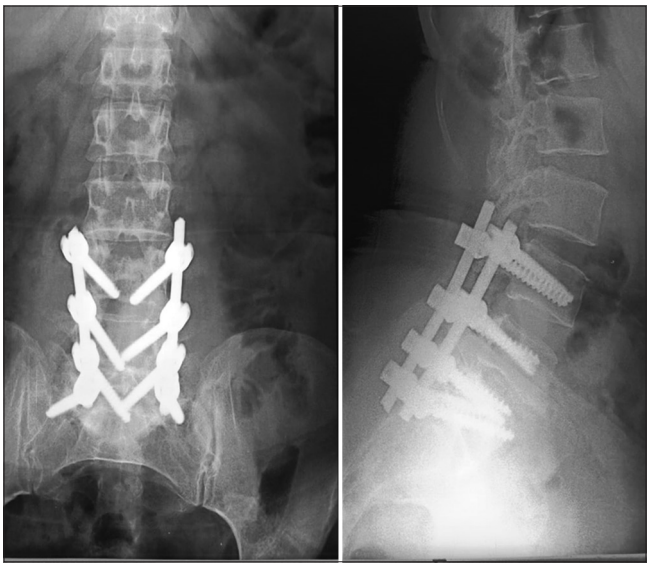

Figure 17: Post correction and extension of fixation – lateral view/ AP X-rays

Discussion

In our study, we reviewed the post-operative complications in cases with surgical indications for lumbar fixation via different operative modalities according to each case and investigated the result of treatment of these complications.

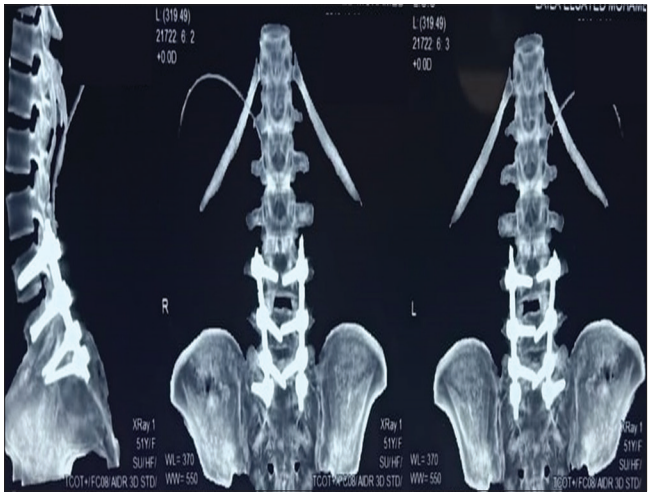

Figure 18: Post correction computed tomography LSS

Evidence shows superior results for patients receiving surgical treatment compared with nonsurgical treatment of degenerative lumbar spondylolisthesis [16].

In our study, 17 patients (34%) were male and 33 (66%) were female, with a ratio of 1:1.9, this result agrees with previous studies, as stated that being approximately 2:1, is higher than the population-based F: M ratio of 1.3:1. This can be explained by the fact that women have a lower threshold for back pain and women are more likely to seek pain treatment than men [8].

Other studies however did not show significantly high female to male ratio in patients, while still having more symptomatizing females [7].

Furthermore, the association between menopause and spondylolisthesis was proposed with the consideration of the higher incidence in postmenopausal women than in age-match men. Before the age of 50 years, spondylolisthesis is rare; and the prevalence of congenital spondylolisthesis is actually more common in men [1].

Low levels of female sex hormones in postmenopausal women can be associated with (1) accelerated degeneration of disc degeneration and disc space narrowing (2) Higher prevalence of osteoarthritis, including that of facet joints, and (3) general laxity of the paraspinal ligaments. It has been shown that hormone replacement treatment preserves muscle strength in postmenopausal women [15].

Regarding age distribution, in our study, the age range was 30–60 with a mean age of 45.9 ± 9.9 years, which is lower than many studies [11], reported a mean age of 54 years in PLIF patients and 57 years in TLIF patients. However, the mean age is higher than other studies [5], which reported mean age of 41 years in their study. However, the sample size of 50 patients in our study does not offer a statistical significance for this result.

BMI was calculated for the study subjects, the mean BMI in the study population was 31.6 with a Standard deviation SD of ± 3.1, which indicate that

obesity plays a significant role in the pathogenesis of spinal instability, generally speaking, obesity is considered as a risk factor in the development of many spinal pathologies, spondylolisthesis being one of them, it is considered as a sort of continuous stress and trauma to the back, especially where the excess weight is located in the abdomen, increasing lordotic strain as an important risk factor of slip progression [6]. Normal BMI ranges from 18.5 to 24.9 in adults, 25–30 is considered overweight, while BMI> 30 constitutes obesity [2].

The most commonly affected levels in our study is L4-5 and L5-S1, being in almost equal numbers among the study population, with 21 patients L4/5 level (42%), and 22 patients at L5/S1 level (44%), and seven patients presented with double level L4/5- L5/S1 (14%).

Our results coincide in agreement with previous larger studies like Park *et al*., in which L4-5 was found to be the most common level of spondylolisthesis affecting 73 patients of 128 in the total number of the patients, representing 57.03% of the total, while L5-S1 was the second most affected level in all single-level cases representing 14 cases in total [11].

Regarding initial clinical presentation prior to fixation, in our study, back pain and neurogenic claudication were the most common presenting symptoms with occurring back pain in all patients (100 %) followed by neurogenic claudication occurring in 22 patients (44%). The least presenting symptom was the sciatica which occurred in 9 patients (18%). Only 6 patients (12%) had palpable step on examination of their back. While 11 patients presented with sensory deficit prior to surgery (22%), Sphincteric disturbance and motor neurologic deficit did not occur in any of the cases.

These results of the presenting symptoms agree with previous studies, where the most common symptoms were low back pain, and mechanical ± sciatica, in a study done on 111 patients with spinal instability, 100 patients complained of low back pain, of which 33 had only LBP and 67 patients had low back pain with lower limb pain [4].

In our study, the most common etiology in our study population was isthmic lythesis in 37 patients (74%), spondylolisthesis in 8 patients (16%), disc prolapse in 4 patients (8%), and only one patient with degenerative lumbar scoliosis (2%). In other studies, however, these percentages might differ slightly, in a larger study by [10], done on 148 cases, the most common etiology was degenerative spondylolisthesis (79 cases) followed by isthmic spondylolysis and spondylolisthesis (56 cases). These results might be attributed to the fact that our study was done on a smaller sample size with no stratification for etiology.

In this study, the patient had various surgical interventions on individual case indications, 17 patients (34%) were operated upon by fixation with decompression, while 11 patients (22%) were operated by fixation with TLIF, 8 patients (16%) were operated by fixation and discectomy, 5 patient (10%) were operated with TLIF and extended decompressive laminectomy, 4 patient (8%) were operated by fixation without step reduction, 3 patient (6%) were operated by TLIF only, one patient (2%) was operated upon by fixation with PLIF and one patient (2%) was operated upon by fixation with correction of the lumbar curve.

This variability might confound the resulting complications, however, the complication rate variability among these interventions were found to be minimal, as found by other studies [6], [11], [14].

Among the studied cases, 39 patients (78%) were operated upon by fixation of one level, nine patients (18%) at two levels, one patient (2%) at 3 levels and one patient (2%) was operated upon by fixation of four levels.

The above-mentioned distribution does not coincide with other studies of post-operative lumbar fixation complications done on 105 patients, there were 37 single-level fusions and 68 multiple-level fusions (2–7 levels). In 34 patients, not every level was instrumented with screws (incomplete instrumentation), in comparison between our study, that might give us a discrepancy in comparing the resulting complications, namely increasing the incidence of infections and neurological deficits due to longer duration of surgery, blood loss, and surgical manipulation, in cases of multiple level instrumental fixation, as discussed in comparing the risk factors with complication rate in literature [7], [12], [13], [14].

In our study, two main themes of complaints can be identified, Mechanical complaints such as low back pain, and Sacro-iliac joint pain, and neurological complaints such as claudication, sciatica, or neurological deficits.

The most common post-operative presenting complaint was the persistent low back pain, with 29 patients out of the 50 cases in this study (58%), and the second most common complaint was Sciatica by 12 patients (24%). While the lesser complaints were:- Sacroiliac joint pain by four cases (8%), neurogenic claudication by 3 cases (6%), and only two cases presented by wound discharge (4%).

Comparing these results to other studies, it is found to be non-conflicting with previous publications to evaluate post lumbar fixation complications, the most common presenting complaint was Back pain with or without sciatica among patients involved in the study (66%), while unlike our study they had a higher rate of neurologic deficits, where The neurologic motor or sensory deficits were presenting symptoms in 30% of the cases while sphincteric disturbance was noted in 4% of the cases [9].

Regarding the positive finding requiring further management in our study, the most common finding

was failed prothesis, found in 9 patients (18%) and adjacent segment failure in nine cases as well, other findings include Sacroiliac dysfunction in 6 cases (12%), posterior cage migration in 5 cases (10%), screw malpositioning in 4 cases (8%), infection in 4 cases, Dural tear in three cases (6%), CSF leak in 2 cases (4%), 7 patients (14%) we found pseudarthrosis, and one patient with pseudo-meningocele.

In other studies, the most common positive finding was instrument failure with 48% of post-operative complications complying with our study, other complications include two cases of infection (8%), two cases of CSF leak (8%), one case of nerve root injury (4%), two cases of pseudoarthrosis (8%), and only one case of DVT [9].

In our study, 32 patients (64%) were managed surgically, while the other 18 patients (36%) were managed conservatively, Out of the 32 patients treated surgically, ten cases were operated upon by extension of fixation (31.2%), six patients were operated upon by correction of mal-positioned screws (18.75%), cage removal done in 5 cases (15.62%), while the rest of cases (11 patients) representing 34.37% of the 32 cases operated, underwent various procedures, namely debridement for 4 cases with infection with prosthesis removal, and repair for CSF leak in two cases, with extended decompression and foraminotomy in five cases.

The patients were followed for a period of 6 months, 40 patients had improved complaints, while ten cases did not improve, out of these 10 cases (20%), 4 patients (8%) had persistent sacro-iliac pain all of whom were treated conservatively, 4 patients (8%) with persistent low back pain, three of which were treated surgically, namely, by extension of fixation due to failed adjacent segment, one treated conservatively, and 2 cases (4%) complained of persistent sciatica, treated conservatively due to absence of surgical indication.

We find that many studies have revealed the effectiveness of various surgeries, including repeated decompression, instrumented fusion, release of adhesion, or total disk replacement with varying success rates, ranging from 35 to 92%, have been reported in a short-term (1 year) follow-up [3].

These results can be explained by the different approaches of surgery in different studies, and varying spinal regions fixed among the studies, with much of the complications depending upon the selected surgical technique.

Conclusion

Our results show a clear role of obesity in the pathogenesis of spondylolisthesis in general. The most affected levels were L4-5, and L5-S1. We also found significant dominance of back pain as a presenting complaint, while neurological deficits were rare. Isthmic lythesis followed by spondylolisthesis as the most common etiologies, respectively, among the studied population.

The most common findings requiring further management were failed prosthesis and adjacent segment failure. Other less frequent findings include Sacroiliac dysfunction, posterior cage migration, screw malpositioning, infection, Dural tear, CSF leak, pseudarthrosis, and pseudo-meningocele.

Conservative management should be tried, but surgical management should be always considered with a good outcome. However, it should be emphasized that our results were limited by the small sample size. Further prospective randomized studies should be carried out, and a meta-analysis is recommended.

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