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ORIGINAL ARTICLE

Outcome of Transforaminal Lumbar Interbody Fusion in Treatment of Single Level Spondylolisthesis

Mohamed Reda Abdelaziz[1], Mahmoud Mostafa Taha[1],Ahmed Gamal Mohamed ElToukhy [1*],Mohammad Ezzat ElSayed[1]
(1)Neurosurgery Department, Faculty of Medicine, Zagazig University, Egypt

Corresponding author*

Ahmed Gamal Mohamed ElToukhy

E-Mail:
a.eltoukhy22@medicine.zu.edu.eg

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ABSTRACT

Background: A common source of morbidity in middle-aged people is lumbar spondylolisthesis. For lumbar segmental instability, spinal fusion combined with instrumentation has emerged as the preferred treatment. Research comparing postoperative improvements in radiography to functional outcomes reveals conflicting results.

Aim of this work: is to reduce post-operative pain and achieving early recovery of patients with spondylolisthesis operated with transforaminal lumbar interbody fusion.

Methods: This Retrospective cohort study was conducted at Neurosurgery Department, Faculty of Medicine, Zagazig University on 24 cases as a comprehensive Clinical trial sample to reduce post-operative pain and achieve early recovery of patients with spondylolisthesis. Patients were subjected to careful history, physical examination and appropriate radiologic evaluation including dynamic radiographs. Preoperative pain by visual analog scale (VAS Score), functional ability by Oswestry Disability Index (ODI) and clinical evaluation were compared with postoperative recordings at the last follow-up. **Results:** Postoperative percent decrease in VAS back pain ranged from 55.6 to 100%. Postoperative percent decrease in VAS sciatic pain ranged from 55.6 to 100%. There is statistically significant decrease in ODI from 23.58 preoperatively to 14.67 postoperative then 6.79 on follow up. All patients can mobilize after 12 hours and 95.8% of them were discharged from hospital after 48 hours and 87.5% had fusion. Only one patient was complicated in form of superficial wound infection.

Conclusion: TLIF is a simple, safe and effective treatment for degenerative lumbar spine disorders with high rates of successful fusion and patient satisfaction with little complications.

Keywords: Lumbar instability, Spinal fusion, Spondylolisthesis, TLIF

Spondylolisthesis is defined as an anterior or posterior slipping of one vertebra relative to the caudal one (Spondylos = vertebrae, Listhesis= slippage). Spondylolysis is known as a unilateral or bilateral defect of the pars interarticularis without slippage. Wiltse first described spondylolisthesis depending on etiological and anatomical changes seen at lumbo-sacral area, this classification divide spondylolisthesis into five categories. The classification was modified by Wiltse and Rothmann to include an extra subtype 6 resulting from previous surgery (Iatrogenic) (Figure 1) [1]. The occurrence of spondylolisthesis in humans is related to their ability to maintain an upright posture and to develop Lumbar lordosis, which is unique to them. It is rare to see a

case of spondylolysis in a child less than 5 years old and is more common to be seen in patients more than 8 years of age. The incidence of spondylolysis is as high as 47% in high-risk sports (e.g., diving and gymnastics) with repetitive hyperextension and rotational loads applied to the lumbar spine. Pars interarticularis defects are twice as common in men as in women; however, women are more likely to progress to spondylolisthesis. The overall incidence of spondylolisthesis is about 4-8% of the general population [2]. When spondylolisthesis is symptomatic, it causes back with/or neuropathy with varying degrees of affection and lower limb discomfort. Fusion is used to treat patients with failed conservative treatment, where successful instrumented fusion is better than non-instrumented fusion. In these situations, the posterior approach is the accepted method for attaining fusion; however, inter-body fusion yields superior outcomes than postro-lateral one as the interbody space is compressed by about 80% of the pressure, but the postro-lateral area is affected only by 20%. Interbody graft can fill 90% of intervertebral surface area in relation to only 10% in the postero-lateral grafts. Also, the vascularity of the interbody area is more and thus adding more to the fusion rate [3]. In interbody reconstruction, a synthetic cage made of PEEK (Polyether Ether Ketone) or metal is used. Prior biomechanical research has demonstrated that the utilization of both anterior and posterior fusion, with reported fusion rates ranging from 90% to 100%, enhanced construct stiffness when compared with posterior fusion alone. The stiffness of the construct is increased by adding posterior fixation in the form of pedicular screws. Harms and Jeszenszky in the 1990 described Transforaminal lumbar interbody fusion (TLIF) as a method of performing anterior fusion from a posterior only approach in treating degenerative spine conditions [4]. Transforaminal lumbar interbody fusion (TLIF) is a specific kind of spine surgery known as "fusion" that combines or fuses the spine's bones permanently. Bone material obtained from a bone bank or transplanted from another location within the patient's body is used in cage or bone graft procedures to achieve fusion. The spine's bones and the bone graft merge to form a single, unified bone throughout time. TLIF has many advantages including reducing the risk of neural retraction and epi-dural fibrosis if compared to a PLIF (Posterior Lumbar Interbody Fusion), avoiding the complications of anterior surgery, that may injure the great vessels or cause retrograde ejaculation if the pre-sacral sympathetic plexus is affected. TLIF also reduces the probability of adjacent segment disease as it preserves the posterior structures like the spinous process, the laminae and posterior ligamentous complex. The clinical and radiographic outcomes with TLIF in patients with degenerative disease or spondylolisthesis are promising [5].The aim of this work is to reduce post-operative pain and achieving early recovery of patients with spondylolisthesis.

PATIENTS AND METHODS

This Retrospective interventional study was conducted at Neurosurgery Department, Faculty of Medicine, Zagazig University on 24 cases as a comprehensive Clinical trial sample for reducing post-operative pain and achieving early recovery of patients with spondylolisthesis. All

participants' or their first degree relatives provided written informed consent, and the study was authorized by the **research ethical council (IRB# 10241-19-12-2022)** at Zagazig University's Faculty of Medicine. The work was done in conformity with the World Medical Association's Code of Ethics (Declaration of Helsinki) for human studies.

Inclusion Criteria: Age ranged from 18 to 70 years old. Both sexes will be included. General fitness for surgery will be consider. Conscious Cooperative patients with consent. Single level spondylolisthesis. Intractable back pain not responding to conservative treatment for at least 6 months. Spinal instability (Clinical and radiological). Oswestry Disability Index questionnaire (ODI) more than or equal 35 %. Exclusion criteria: Patient age below 18 years or above 70 years old. Osteoporotic Patient. Multiple level spondylolisthesis. Fracture dislocation with sever kyphotic or scoliotic angle. Active infection. Vertebral tumors (primary or secondary). Pregnancy and Drug or alcohol abuser and psychological disorders that could affect follow-up care or treatment outcomes.

All patients were subjected to the following:

General examination to assess the patient general fitness for operation.

Local examination to the lumbar spine to evaluate any deformity, scar of previous operation, tender points and range of motion of the lumbar spine was done to all the patients.

Neurological examination of motor, sensory and reflexes of both upper and lower limbs was done to all the patients.

Laboratory evaluation: Complete blood picture, Blood sugar, Liver and kidney functions, Bleeding Profile, Urine analysis, Hepatitis markers.

X ray: Static (anterior-posterior and lateral) and dynamic (flexion and extension) plain lumbar spine standing radiographs were evaluated. Long standing film from occiput till coccyx anterior-posterior and lateral was taken before the operation.

CT (Computed Tomography): when needed to confirm the pars defect and any dysplastic changes (Figure 2).

MRI (Magnetic Resonance Imaging): sagittal and axial view for all the patients (Figure 3).

Dexa scan (Dual-Energy X-ray Absorptiometry Scan): to exclude patients with osteoporosis.

Operative technique: After endotracheal anesthesia, the patient is placed in a prone position with avoidance of epidural venous distention from abdominal compression. Posterior spinal elements are exposed through a midline longitudinal incision. A subperiosteal dissection of the paraspinous muscles is completed to the transverse processes. Pedicle screws are sized and inserted under C-arm x-ray guidance before decompression to minimize blood loss and achieve distraction (Figure 4). If radiculopathy is present, the spinal canal is entered through a unilateral laminectomy and inferior facetectomy on the side of the radicular pain. If no radiculopathy is present, the side is chosen arbitrarily. Then we apply the rod system at the contralateral side and distract the disk space. The next step is to gain access to the disk via the transforaminal

approach. The inferior articular process of the cranial vertebra is now thinned out with the use of a burr, while distraction forces are applied to the contralateral side. Once thinned, resect the inferior articular process of the cranial vertebral body.The capsular part of the ligamentum flavum is now visible and can be resected. To avoid damage to the nervous structures, it is necessary to cut around the superior articular facet of the caudal vertebral body. Tactile exploration of the neural foramen is recommended with palpatory identification of the cranial nerve root and the position and breadth of the pedicle of the caudal vertebral body. Resect the superior facet of the inferior vertebra as the final step in gaining access to the disk, the posterolateral parts of the annulus fibrosus, and the longitudinal ligament. The entire neural foramen is identified after resection of the upper medial parts of the superior articular facet of the lower vertebral body (Figure 5-A). The nerve root can be identified merely by palpation in its course within the foramen, especially where it crosses over the lateral parts of the intervertebral space. The origin of the next nerve root in the caudal direction and the dural sac in the medial border can also be identified. After identification of these nervous structures, meticulous coagulation of the epidural veins in the neural foramen is carried out. The thecal sac is gently retracted medially, if necessary (Figure 5-B). Partially we clear the intervertebral disk compartment by using various rongeurs. Curettes can be used to remove the intervertebral disk remnants adhering to the upper plates. With the curettes, the cartilaginous coats of the end plates can be removed at the same time without destroying the osseous structure of the end plates (Figure 5-C). After the initial discectomy, gradual distraction is applied to the pedicle screws on the opposite side. An osteotome is used to remove the posterior lateral lip of concave bone to achieve a flat end plate surface [6]. After dilation to an appropriate size, the trial implant was placed with care taken to tamp it appropriately medial and anterior. After implant trialing, the interspace should be bone grafted with the graft material from removed lamina and facet joint (Figure 5-D). Bone graft was placed into the anterior interspace and the implant. After anterior grafting of the interspace, the implant cage with graft is placed, and tamps are used to direct the implant anterior and medially (Figure 6). Cage position is confirmed by intraoperative imaging of fixed markers on the cage. These markers are showing the anteroposterior and the lateral cage position. Rods should be measured, cut, and bent into the appropriate lordosis and then captured in the pedicle screws. An intraoperative image must be obtained at this point to confirm pedicle screw and interbody cage placement, with care taken to note the anterior position of the cage (Figure 7) [7]. Insert drains and carry out the muscle closure, followed by fascia suture, subcutaneous suture, and finally skin closure. At the end of surgery, these patients were documented for: Blood loss - Operative time - Cage size - Level of surgery and Number of levels operated upon

Post-operative management and Ambulation protocol:

Patients were instructed to ambulate from day one after operation. Lumbosacral support was worn for two weeks for psychological support. Isometric exercise of

abdominal and back muscles also started in the third day of surgery. Intravenous antibiotic was received for about 5 days after operation then oral for 10 days more. Analgesia was continued for 48 hours then as needed by the patient.

Follow up:

Patients were checked in one month, three months, six months, and subsequently every six months. The ODI questionnaire and VAS of back and leg pain were used to track patients' clinical and radiological progress by AP and lateral radiology at each visit or X-ray or CT scanning at the final follow up visit (Figure 8). Preoperative Oswestry Disability Index (ODI) and visual analogue scale scores (VAS) for back and leg pain, were compared with postoperative recordings at the last follow-up.

Statistical analysis:

Data analysis was performed using the software SPSS (Statistical Package for the Social Sciences) version 26. Shapiro-Wilk test was used to verify assumptions for use in parametric tests. Quantitative variables were described using their means and standard deviations or median and range according to type of data. To compare quantitative data between two groups, to measure change in one variable between two points of time, Wilcoxon signed rank test was used. The level statistical significance was set at $P < 0.05$. Highly significant difference was present if $P \leq 0.001$.

RESULTS

Table (1) showed that the average preoperative back visual analogue score of the patients tested was 7.33, with a range of 5 to 10. The majority of our patients (17/24 (70.8%) had scores ranging from 7 to 8, 3/24 (12.5%) had scores ranging from 9 to 10, 4/24 (16.7%) had ratings ranging from 5 to 6, and no patients had values ranging from 0 to 4. Table (2)revealed that the average preoperative sciatic visual analogue score of the patients analyzed was 7.04, with a range of 4 to 9. The majority of our patients (16/24, or 66.7%) had a score of 7 to 8, while 2/24, or 8.3%, received a score of 9 to 10. 1/24 (4.2%) had a score of 3 to 4, 5/24 (20.8%) had a score of 5 to 6, and no patients had a score of 0-2.Preoperatively, 5/24 (20.8%) had moderate ODI, 12/24 (50%) had severe disability, 7/24 (29.2%) were crippled on ODI and no patients had mild disability on ODI. ODI ranged from 35 to 80% with mean 54.58% as shown table (3).Operative time ranged from 105 to 180 minutes with mean 133.54 minutes as shown table (4). Blood loss ranged from 130 to 400 cc with mean 223.75 ccas shown table (5).Table (6) showed that 21 patients (87.5%) had fusion. Only one patient was complicated in form of superficial wound infection. Table (7) showed that the preoperative VAS ranged from 4 to 9 with median 7 which significantly reduced to a range from 0 to 4 with median 1 postoperatively then it significantly reduced to a range from 0 to 2 with median 0.5. Postoperative percent decrease in VAS sciatic pain ranged from 55.6 to 100% with median 85.7% while on follow up, percent decrease in VAS ranged from 71.4 to 100% with median 100%. Table (8) showed that preoperative VAS back pain ranged from 5 to 10 with median 7.33 which significantly reduced to a range from 0 to 4 with median 2 postoperatively then it significantly reduced to

a range from 0 to 3 with median 1. Postoperative percent decrease in VAS back pain ranged from 55.6 to 100% with median 75% while on follow up, percent decrease in VAS ranged from 66.7 to 100% with median 100%.Table (9) showed that there was statistically significant decrease in ODI from 23.58 preoperatively to 14.67 postoperative then 6.79 on follow up. Percent decrease in ODI postoperatively ranged from 60 to 80% with median 70% while percent decrease on follow up as compared to preoperative level ranged from 60 to 92% with median 83.82%.

Table (1): Distribution of the studied patients according to preoperative VAS back pain.

	N=24	%
5 – 6	4	16.7%
7 – 8	17	70.8%
9 – 10	3	12/5%
	Mean ± SD	**Range**
VAS back pain	7.33 ± 1.17	5 – 10

Table (2): Distribution of the studied patients according to preoperative VAS leg sciatic pain.

	N=24	%
3 - 4	1	4.2%
5 – 6	5	20.8%
7 – 8	16	66.7%
9 – 10	2	8.3%
	Mean ± SD	**Range**
VAS sciatic pain	7.04 ± 1.23	4 – 9

Table (3): Distribution of the studied patients according to preoperative ODI.

	N=24	%
ODI:		
Mild (0 – 20%)	0	0%
Moderate (21 – 40%)	5	20.8%
Severe (41 – 60%)	12	50%
Crippled (61 – 80%)	7	29.2%
	Mean ± SD	**Range**
ODI (%)	54.58 ± 13.75	35– 80%

Table (4): Operative data the studied patients.

	Mean ± SD	Range
Operative time (min)	133.54 ± 19.64	105 – 180

Table (5): Intraoperative blood loss the studied patients.

	Mean ± SD	Range
Blood loss (cc)	223.75 ± 67.04	130 – 400

Table (6): Distribution of the studied patients according to postoperative clinical evaluation.

	N=24	%
Fusion		
Yes	21	87.5%
No	3	12.5%

Table (7): Change in VAS sciatic pain findings pre and postoperatively among the studied patients.

VAS sciatic	Time			Test	
	Preoperatively	Postoperatively	Follow up	P_1	P_2
	N=24 (%)	N=24 (%)	N=24(%)		
Mean ± SD **Median (Range)**	7.04 ± 1.23 7(4 – 9)	1.29 ± 1.0 1(0 – 4)	0.5±0.72 0(0 – 2)	<0.001**	<0.001**
% decrease **Median(range)**		85.7 (55.6–100%)	100 (71.4 –100%)		

**p≤0.001 is statistically highly significant Wilcoxon signed rank test p1 difference between postoperative and preoperative value p2 difference between follow up and postoperative value.

DISCUSSION

In middle-aged people, lumbar spine instability due to degenerative etiology is a prevalent issue that primarily affects the lower lumbar region motion segments. Under the physiological strain of daily activities, articular facets and discs degenerate, resulting in aberrant motion and instability. The resulting spondylolisthesis primarily has an activity-related origin and presents clinically as low back pain with radiculopathy. For patients with symptomatic spondylolisthesis who have not responded to conservative treatment, spinal fusion has emerged as the gold standard. In these individuals, segmental stability is restored and a favorable outcome is achieved with adequate neural decompression, stabilization, and fusion. Strong Pain resulting from instability at that lumbar spine motion segment is lessened by spinal fusion [8].

There are various methods for interbody fusion, such as transforaminal lumbar interbody fusion (TLIF), anterior lumbar interbody fusion (ALIF), posterior, and lateral, and each has pros and cons unique to it [9]. The TLIF is one of the most often performed procedures due to its many benefits, which include less traction on the dura and nerve root, a decreased risk of postoperative radiculitis, instrument availability, and surgeon familiarity with the technique [10].

An alternate procedure that circumvents both the anterior route and the approach through the spinal canal is transforaminal lumbar interbody fusion (TLIF). It should theoretically avoid common issues, like those that arise from anterior and

posterior lumbar interbody fusion. One benefit of this technique is that it is simple to implement unilaterally. This maximizes fusion stability by causing less instability of the spine and less damage of the posterior components. Moreover, it lessens the necessity for manipulating the spinal nerve roots and provides improved access to the neuroforamen. As a result, nerve damage that could result from retraction could be prevented [11].

Our study showed the outcome of transforaminal lumbar interbody fusion (TLIF) using interbody cages with posterolateral fixation in single level spondylolisthesis.The twenty-four patients included in this prospective study were with age ranged from 23 to 59 years with mean 42.79 years. Two thirds of studied patients aged from Male represented 62.5%. According to our research, the preoperative back visual analogue score of the patients under investigation was, on average, 7.33, ranging from 5 to 10. Among our patients, the majority 17/24 patients (70.8%) had scores from 7 to 8, 3/24 patients (12.5%) rated between 9 and 10, or 4 out of 24 (16.7%) had a score between 0 and 4, and none of the patients received a score between 5 and 6.In the research conducted by Balasubramanian et al [8] involving 35 patients, the average preoperative VAS score was 8 ± 0.7. Guangfei et al [12] also reported a score of 7.4±1.0, which is comparable to our numbers.The average preoperative visual analogue score for sciatic leg pain among the patients in our study was 7.04, with a range of 4 to 9. Among our patients, the majority 16/24 patients (66.7%) had a score from 7 to 8 and 2/24 patients (8.3%) rated on a scale of 9 to 10. Of the patients, 5/24 (20.8%) had scores between 5 and 6, no patient had a score between 0-2, and 1/24 (4.2%) had a score between 3 and 4.Balasubramanian et al [8] reported that the mean preoperative VAS leg was 8, which is consistent with our findings. Also, a mean preoperative VAS leg of 7.7 was observed by Guangfei et al [12]. In our study we found Preoperatively, 5/24 (20.8%) had moderate ODI, 12/24 (50%) had severe disability, 7/24 (29.2%) were crippled on ODI and no patients had mild disability on ODI. ODI ranged from 35 to 80% with mean 54.58%.

The average operating duration for the patients under investigation was discovered to be 133.54 minutes. 180 minutes was the longest operation time, and 105 minutes was the shortest.Kazim et al [11], who reported an operative time of 146.6 ± 23.4 minutes, and Lee et al [14] who reported an operative time of 128.83±33.23 minutes, both agreed with our findings.

223.75 cc was the mean surgical blood loss of the participants in our study. There was a 400-cc maximum and a 130-cc minimum blood loss.Similarly, Lee et al [14] had a mean blood loss of 253.83 ± 104.75 mL, Kazim et al [11] had a mean blood loss of 248.75 ± 62.93 which is within our range.

In order to determine the fusion rate, we followed up with each patient for six months in our study. We discovered that 87.5% of the patients had a firm fusion. Eighty percent of the patients in the study by Balasubramanian et al [8] had a firm fusion. Additionally, Zhang et al [13] report of a firm fusion in 90.29% is similar to what we found.The patients under investigation had a mean postoperative back visual analogue score of 2.88, ranging from 1 to 5. Of our patients, 10/24 (41.7%) had scores between 0 and 2, 10/24 (41.7%) had scores between 3 and 4, 4/24 (16.7%) had scores between 5 and

6, and no patient had a score between 7 and 10.

According to Zhang et al [13] and Balasubramanian et al [8], the mean postoperative back VAS was 2.3±0.7, which is in line with our findings. The mean postoperative back VAS was 2.3±0.7, which is in line with our findings.The patients under investigation had a mean postoperative sciatic visual analogue score of 1.29, ranging from 0 to 4. The majority of our patients (22/24, 91.7%) had ratings between 0 and 2, while 2/24 patients (8.3%) had scores between 3 and 4, and no patient had a score higher than 4.Balasubramanian et al [8] reported a mean postoperative back VAS of 1.5, whereas Zhang et al [13] reported a mean postoperative leg VAS of 2.2±0.9, which is consistent with our findings.Following surgery, 4/24 (16.7%) had moderate ODI and 20/24 (83.3%) had mild ODI. With a mean of 21.46%, the ODI varied from 6 to 40%. In comparison, the mean postoperative ODI of this study was improved to 35.35 in Kazim et al [11], to 25 in Balasubramanian et al [8], and to 21.8 in Zhang et al [13].

In our study, we found statistically significant decrease in ODI from 23.58 preoperatively to 14.67 postoperative then 6.79 on follow up. Percent decrease in ODI postoperatively ranged from 60 to 80% with median 70% while percent decrease on follow up as compared to preoperative level ranged from 60 to 92% with median 83.82%. In this sense, our findings are consistent with a wide range of earlier research, including Shunwu et al [15], Lee et al [14], Zhang et al [13], Balasubramanian et al [8] and Kazim et al [11].

CONCLUSION

TLIF is a simple, safe and effective treatment for degenerative lumbar spine disorders with high rates of successful fusion and patient satisfaction with little complications.

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List of Abbreviations:

ALIF: Anterior Lumbar Interbody Fusion

AP: Anteroposterior

CT: Computed tomography

Dexa Scan: Dual-Energy X-ray Absorptiometry Scan

L4: Lumbar vertebra 4

L5: Lumbar vertebra 5

MRI: Magnetic Resonance Imaging

ODI: Oswestry Disability Index

PEEK: Polyether Ether Ketone

PLIF: Posterior Lumbar Interbody Fusion

SPSS: Statistical Package for the Social Sciences

TLIF: Transforaminal Lumbar Interbody Fusion

VAS: Visual Analog Scale

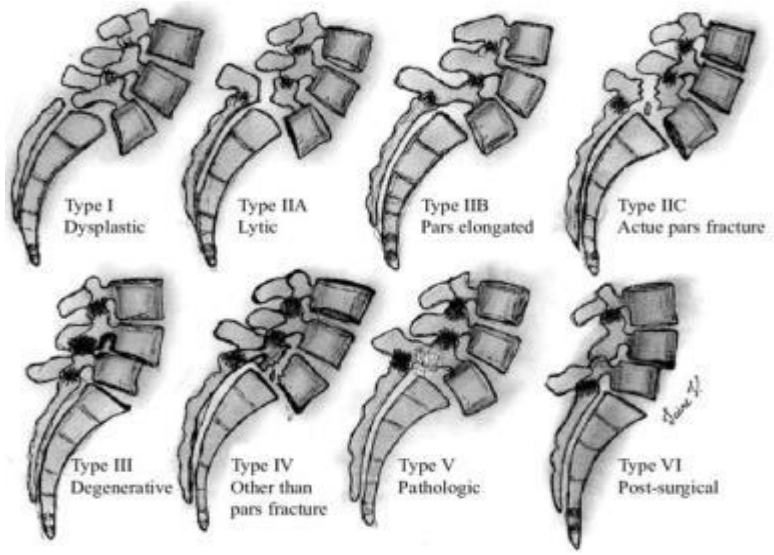


Figure S1: Illustration of the modified Wiltse& Newman. Classification of spondylolisthesis [1].

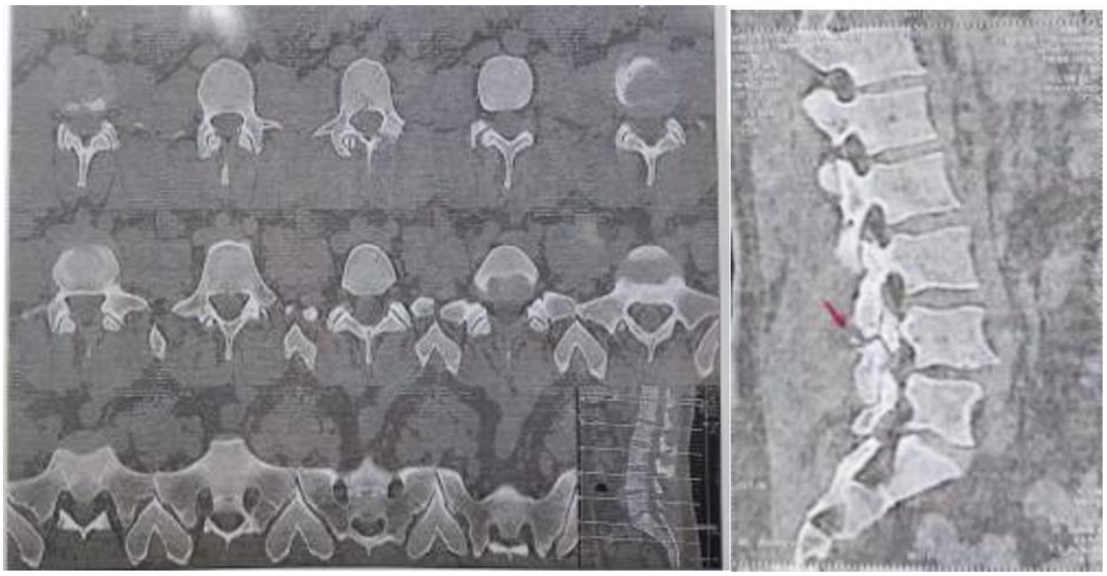


Figure S2: Preoperative CT lumbosacral spine Axial & Sagittal view of male patient 51 years old, with L4-L5 first degree isthmic spondylolisthesis

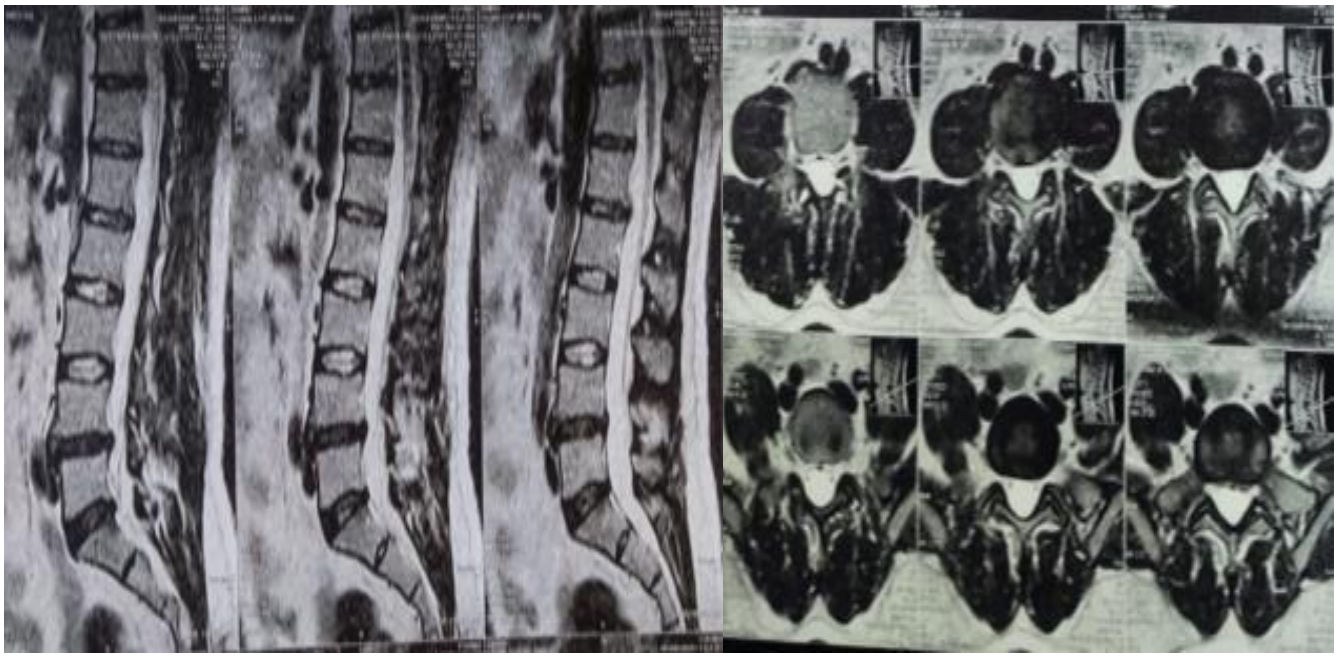


Figure S3: Preoperative MRI lumbosacral spine T2-weighted images sagittal and axial view of male patient 51 years old, showing L4-5 spondylolisthesis with pseudo disc prolapse.

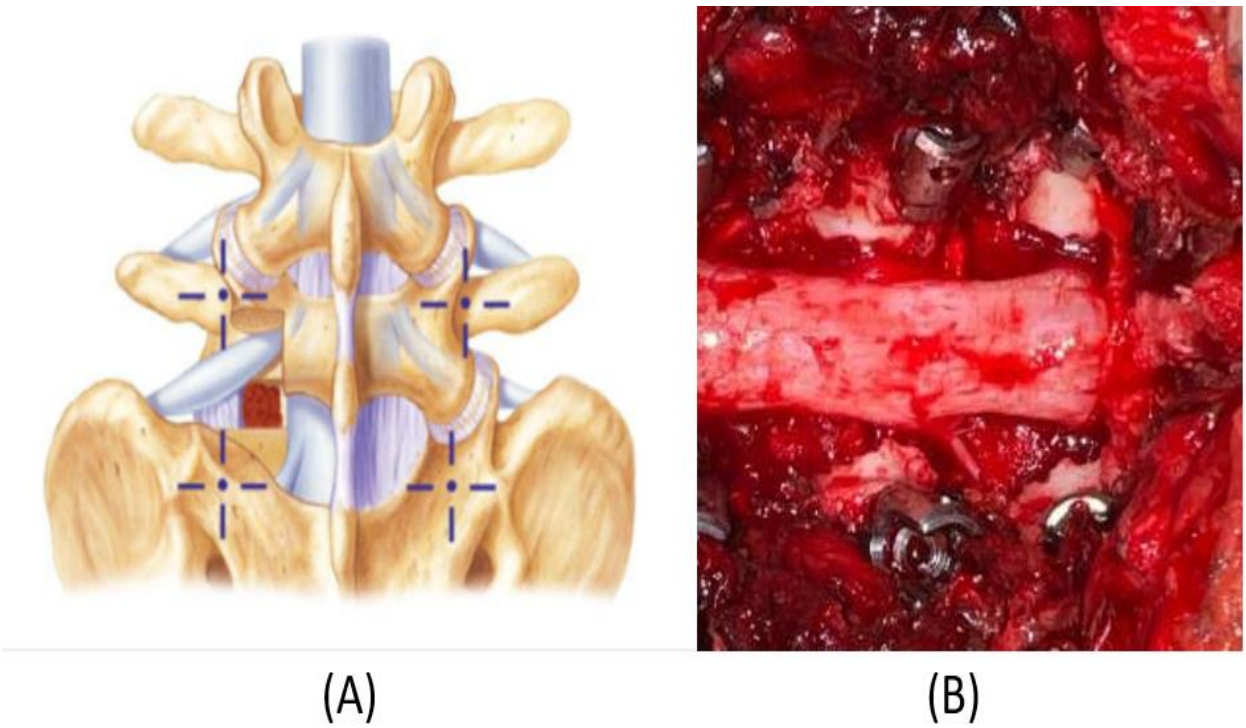
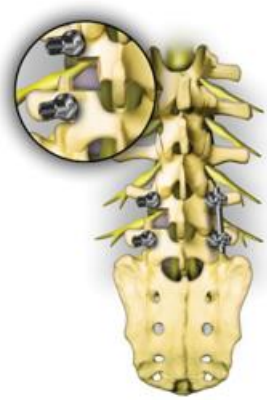


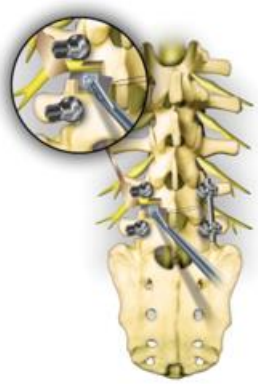
Figure S4: Poly-axial pedicle screws are placed after completing exposure.

A.) The proper position of the pedicle screws entry point. [7].

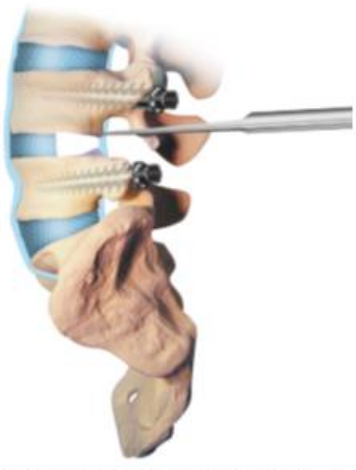
B.) An intraoperative photography after the insertion of the pedicle screws.



(A): After resection of the upper medial parts of the superior articular facet, the neural foramen is opened **[6].**



(B): The thecal sac is gently retracted medially, if necessary. The diskectomy is performed through this unilateral approach **[6].**



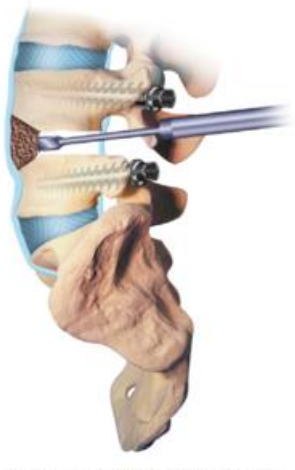
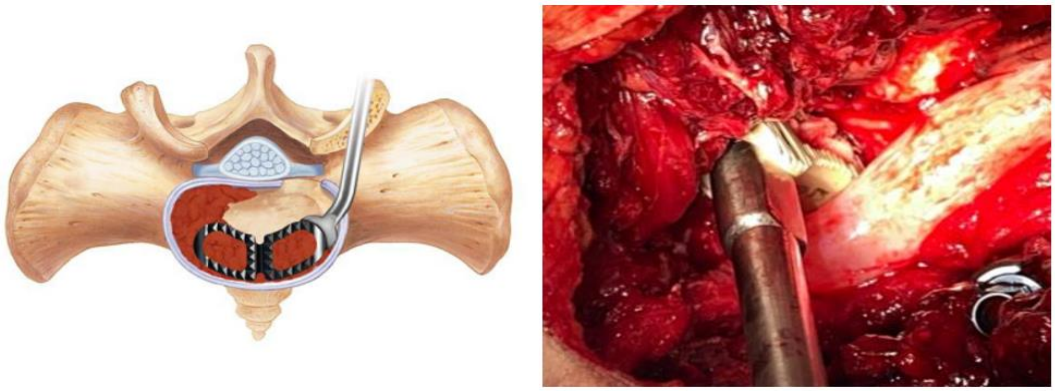


Figure S5: TLIF, Discectomy and bone grafting [6] [16].



(A) (B)

Figure S6: (A): Bone graft should be placed into the anterior interspace and the implant [7]. (B): Intraoperative Cancellous bone graft inside cage.

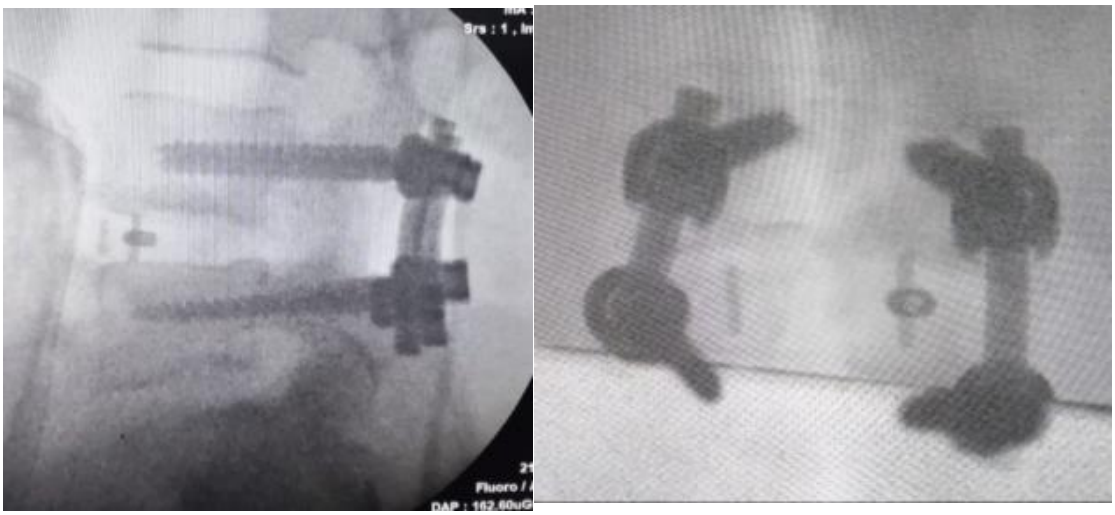


Figure S7: C-Arm photo intra-operative Lateral &Antroposterior view showing L4-L5 fixation by 4 screws with cage insertion at L4-5 level.

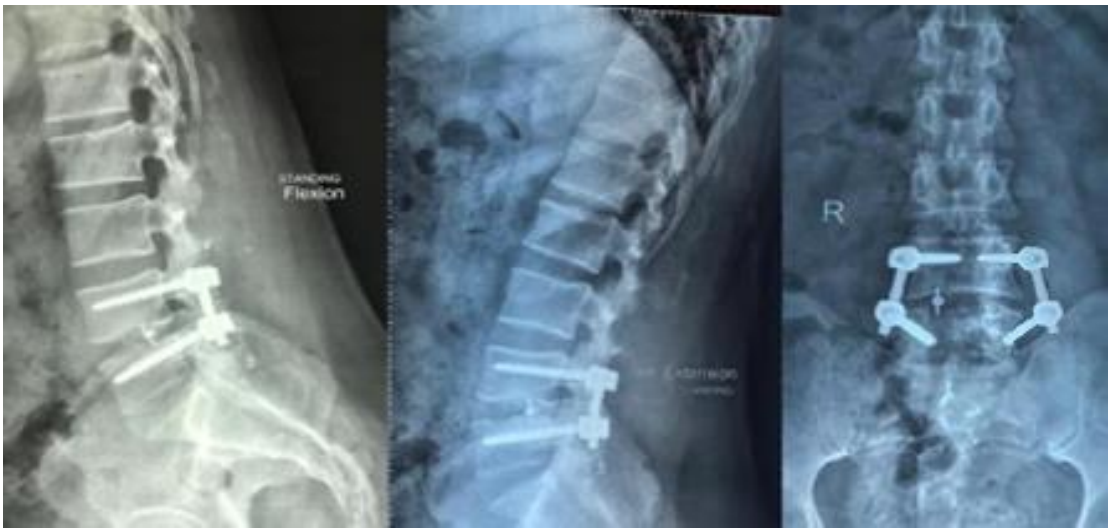


Figure S8: Postoperative follow up plain X-ray lumbosacral spine. Flexion, Extension

&Antroposterior views of male patient 51 years old, showing L4-L5 fixation by 4 screws & 2 rods with cage insertion at L4-5 level.

Table S1: Change in VAS back pain findings pre and postoperatively among the studied patients.

VAS back pain	Time			Test	
	Preoperatively	Postoperatively	Follow up	P_1	P_2
	N=24 (%)	N=24 (%)	N=24(%)		
Mean ± SD Median (Range)	7.33 ± 1.17 7(5 – 10)	1.83 ± 1.17 2(0 – 4)	1 ± 0.93 1(0 – 3)	<0.001**	<0.001**
% decrease Median(range)		75 (55.6–100%)	100 (66.7–100%)		

**p≤0.001 is statistically highly significant Wilcoxon signed rank test, p1 difference between postoperative and preoperative value p2 difference between follow up and postoperative value

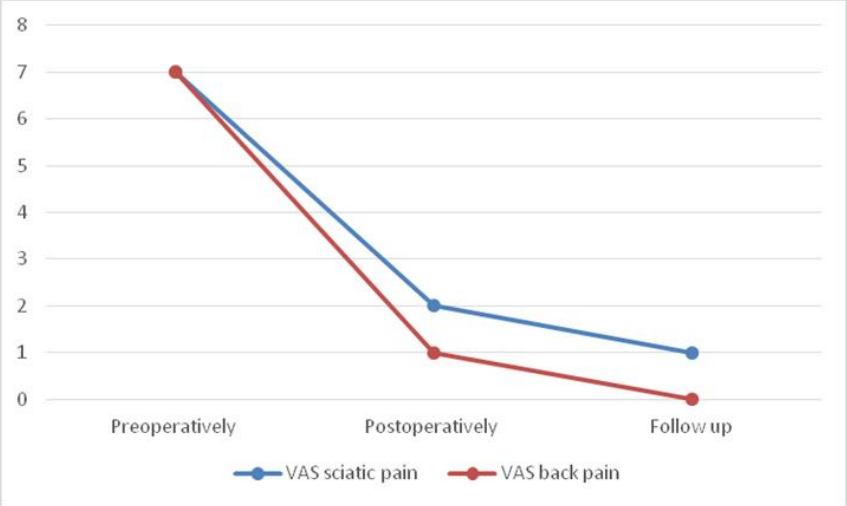


Figure S9: Line graph showing change in VAS pain among studied patients.

Table S2: Change in ODI findings pre and postoperatively among the studied patients.

ODI	Time			Test	
	Preoperatively	Postoperatively	Follow up	P_1	P_2
	N=24 (%)	N=24 (%)	N=24(%)		
Mean ± SD Median(Range)	54.58 ± 13.75 50 (53 – 80)	14.67 ± 5.45 6 – 25	10.17 ± 6.75 9.45 (4 – 30)	<0.001**∞	<0.001**∞
% decrease Median(range)		70(60 –80%)	83.82(60–2%)		

∞ Paired sample t test*p<0.05 is statistically significant. §Wx Wilcoxon signed rank test significant

p1 difference between postoperative and preoperative value,p2 difference between follow up and postoperative value.

DISCUSSION

Our study showed that the age of studied cases ranged between 56 years to 77 years with mean age was 65.53± 5.35 years. Regarding gender, there were 198 (58.8%) males and 139 (41.2%) females with male to female ratio was 1.42:1.Nugraha *et al*. [7] who found that the female gender was more prevalent and that age was over 70. This difference may be due to different populations.

Our study showed that regarding comorbidities, 85 (25.2%) patients had DM, 211 (62.6%) patients were hypertensive, 160 (47.5%) had hyperlipidemia, and 64 (19%) were smokers. 52 (15.4%) patients had previous history of peripheral vascular disease.Nugraha *et al*. [7] who found that comorbidities, (25.2%) patients had DM, (62.6%) patients were hypertensive, and (20%) were smokers. (17%) patients had previous history of peripheral vascular disease and our results agree with that.

This study showed that regarding diagnosis, most studied cases (92.9%) patients had non-ST-elevation myocardial infarction (NSTEMI), while 24 (7.1%) patients had ST-elevation myocardial infarction (STEMI).Chen *et al*. [8] who found that 2,381 eligible participants were included in the study out of the 2,520 patients enrolled in the BRIC-ACS study who had a definitive diagnosis of ACS and had undergone PCI with DES: 1,012 patients (42.5%) had unstable angina, of whom 934 patients (39.2%) had STEMI and UA435 patients (18.3%) had NSTEMI and our results agree withthat.

Our study showed that mean weight, and height were 85.42± 6.11 kg, and 1.72± 0.11 m respectively. The mean BMI in studied cases was 29.18 ±4.37 Kg/m^2. Also, the mean hemoglobin level was 13.07± 1.17 g/dl. The mean WBCs and platelets count were 8.55± 1.18 x10^9/ L and 231.96± 14.94 x10^9/ L respectively.Our results disagreement with Généreux *et al*. [9] who found that individuals with peripheral arterial disease (PAD), congestive heart failure, hypertension, hyperlipidemia, prior MI, and prior coronary revascularization were older, more often female, and had PDB within two years. Hemoglobin and creatinine clearance values were similarly lower at baseline in PDB patients. This may be due to different sample size and the differences in the techniques and normal range of laboratory tests.

Our study showed that post-discharge bleeding was observed in 44 (13.1%) cases. Out of those 44 cases, 27 cases reported GIT bleeding while 17 cases reported vascular access of PCI bleeding. The mean bleeding amount was 52.27± 42.08 ml. The mean bleeding time was 25.95± 6.95 seconds. From History taking of bleeding from patient nearly determined them. The mean hemoglobin drop time was 2.507± 0.08 g/dl.Généreux *et al.* [9] who found that PDB occurred in 535 of 8,577 hospital survivors (6.2%) at a median time of 300 days (interquartile range: 130 to 509 days) post-discharge. The most common cause of PDB (61.7%) was bleeding in the gastrointestinal tract. These results are consistent with the predicted markers of PDB, which included older age, lower baseline hemoglobin, reduced platelet reactivity on clopidogrel, and long-term oral anticoagulant drug use.

Also, our results agreement with Marquis *et al*. [10] who found the death rates did not differ statistically from those of patients who did not have post-discharge bleeding (p 0.095). It was discovered that there were statistical differences in the adjusted HRs between the various time periods since bleeding ($p < 0.001$).

Following PCI, bleeding-related hospitalization following discharge was linked to later death or MI (hazard ratio: 3.09; 95% confidence interval: 2.41–3.96), with the first 60 days following bleeding-related hospitalization carrying the highest risk of death or MI (hazard ratio: 7.16; confidence interval: 3.93–13.05) [11].This study showed that regarding outcome, most cases (86.1%) discharged, 3.3% reported chest pain and acute coronary syndrome that needed

hospitalization, and 9.8% were on conservative management. None of died cases was reported in our study. Also, post-discharge bleeding was significantly higher in male cases compared to female cases ($p<0.001$) while no statistically significant difference was observed between the two groups regarding age ($p>0.05$).Généreux *et al*. [9] revealed the age differences were statistically significant. Additionally, our results concur with the very statistically significant difference regarding sex (p value <.05).

We found that post-discharge bleeding was significantly higher in cases used streptokinase before PCI ($p<0.001$). While no statistically significant relation was observed between post-discharge bleeding and use of antiplatelets or 1st aid anticoagulant ($p>0.05$).Our results are in agreement with Sezer *et al.* [12] who found that Two days before PCI, all measures of microvascular function (means ±SD) were significantly better in the streptokinase group than in the control group.

According to our findings, there was a statistically significant correlation between the number of lesions ($p=0.038$), the position of the lesion ($p=0.01$), and the number of vessels ($p<0.001$) and post-discharge bleeding. However, there is no statistically significant correlation ($p>0.05$) between the vascular access site and post-discharge bleeding. Post-discharge bleeding and outcome had a statistically significant relationship ($p<0.001$) in patients with ACS.Généreux *et al*. [9] they discovered that PDB was linked to greater crude rates of death from all causes (13.0% vs. 3.2%; $p < 0.0001$). PDB was substantially correlated with 2-year mortality after multivariable correction (hazard ratio [HR]: 5.03; $p < 0.0001$). Our findings support that.

Declaration of interest:

The authors report no conflicts of interest.

The authors along are responsible for the content and writing of the paper.

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CONCLUSION

We can make prediction and reduction of bleeding upon discharge from percutaneous coronary intervention by control the risk factors, the proper daily use of PPI medications with DAPT and caution of flexion and extension of hip joint at site of vascular access of PCI in first 24 hours after discharge from hospital. More research is needed to fully comprehend how various categories of bleeding severity affect a patient's prognosis with acute ischemic patients that treated with PCI.

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