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STUDY OF FUNCTIONAL OUTCOME OF SURGICAL MANAGEMENT IN SPONDYLOLISTHESIS TREATED WITH PEDICLE SCREW FIXATION AND POSTERIOR LUMBAR INTER BODY FUSION

Orthopaedics

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ABSTRACT

The purpose of this study is to evaluate decompression, reduction and instrumentation for high grade spondylolisthesis with posterior lumbar interbody fusion technique in

1.To assess the clinical and radiological outcome of pedicle screw fixation and posterior lumbar interbody fusion

2.To assess the clinical outcome by using Oswestry Disability Score comparing pre operative scores with post operative (1 month, 3 months, 6 months and 1year) scores

3.To evaluate radiological out come at end of three months and one year follow up by assessing correction of slip and progression of slip and achievement of fusion

4.To evaluate the post operative complications

METHODS: Study type: This study is a hospital based prospective study of clinical and radiological analysis of posterior lumbar interbody fusion using pedicle screw fixation in spondylolisthesis

Study area: study was carried out in orthopaedic department of Katuri medical college and hospital, Chinakondrupadu, Guntur from October 2016 to September 2018

RESULT : All 30 patients in the present study returned for clinical and radiological examinations subsequently. Patients were reviewed after 1months,3months,6months and 1year postoperatively. Radiographs were reviewed at end of 1months,3months and 1year

Observations in the form of tables, pie charts and bar diagrams are furnished

CONCLUSION: The outcome showed high fusion rate and excellent clinical outcome in terms of pain relief and functional capabilities. Patients are satisfied with results and most of them resumed their normal activities and are pursuing their routine work.

KEYWORDS

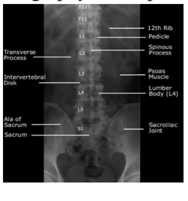
INTRODUCTION

The term spondylolisthesis is derived from Greek word (spondylos – vertebra, olisthesis – to slip or slide down a slippery path). It is defined as anterior or posterior slipping of one vertebra on another. Herbineaux[1], a Belgian obstetrician was the first to identify it. But the term was first coined by Killian.

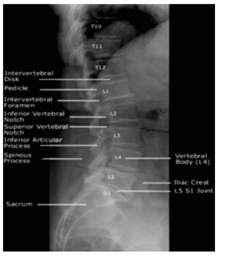
It is one of the common conditions of the lumbar spine resulting in low back pain which could be either static or radiating in nature. Forward slippage is called anterior or forward listhesis and backward slippage is called retrolisthesis, the former is most common. Prevalence of spondylolisthesis in general population is 5% and the incidence of degenerative spondylolisthesis seen in women is twice that compared with men[2,3]. Treatment options include any one of the following techniques suchas decompression, posterolateral fusion with or without instrumentation and interbody fusion. All these have produced varying degree of success and contributed their own share of complications.

INVESTIGATIONS

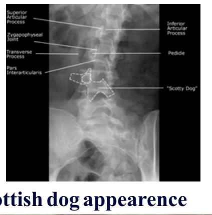
1) Plain radiographyViews Anteroposterior(AP) and Standing lateral view Ferguson's AP view (30 degrees caudal tilt) Oblique view ("Scotty dog" profile) Dynamicradiography-Flexion - extension latera lviews Compression - traction radiography Anteroposterior view Lateral view



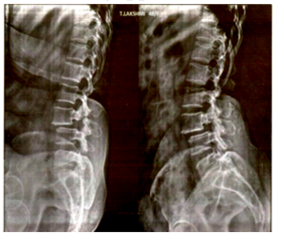
Anteroposterior view



Lateral view



Oblique view with Scottish dog appearence



Stress views

Uses of special views
- Identifies lucency suggesting pars fracture in case of isthmic type.
- Loading of the spine to translate any listhesis, making it and the pars

fracture more visible.
- Identifies as many as 19% of pars fracture that would be missedotherwise.
- Preop planning and for identifying hypermobility.

- Ferguson's AP view is useful in the postoperative assessment of posterolateral fusion mass which is often obscured by the sacral ala on routine Apview.

Plain radiography is the key to diagnosis.

Roentgenographically spondylolisthesis is graded by Meyerding in to 4 grades. Slipgrade is calculated by determining the ratio between the AP diameter of top of S1 and the distance the L5 vertebra has slipped anteriorly.

POSTERIOR LUMBAR INTERBODY FUSION (PLIF)
It affords the surgeon the opportunity to fuse all three columns of the affected spinal segment through single posterior incision. PLIF has a sound biomech rationale because the compression forces in the lumbar spine passes anteriorly through the disc space.

The technique was introduced first in 1945 by CLOWARD[15] to treat lumbar disc herniation. The initial popularity declined as high rate of pseudoarthrosis and graft dislodgement became evident. Steffee and Sitkowski[43] recognized that a structural graft placed in the disc space would divert some of the load, decreasing the forces on the posterior instrumentation, and reduce the frequency of instrumentation failure. Another development that favored the adoption of PLIF was the invention of the interbody fusion cage by Brantigan and the titanium mesh cage by Harms. Their designs eliminated the need to harvest a structural graft from the iliac crest, which was a major source of morbidity previously associated with the PLIF procedure. The cage provided the structure[44]and the osteogenic potential for fusion came from cancellous

bone packed into the cage, which could be obtained from the iliac crest more easily than a structural graft, with less injury to the patient. Recent advances in instrumentation and technique have resulted in an increased use of PLIF technique with threaded interbody fusion cages.

Indications for PLIF with pedicle screw fixation:
1. Isthmic spondylolisthesis
2. Degenerative or spondylotic spondylolisthesis
3. Long lumbar fusion in lumbosacral psuedoarthrosis
4. Lumbar disc herniations
5. patients with pseudarthrosis after failed posterolateral fusion
6. scoliosis or kyphosis or flatback deformities

Cage design and characteristics:
The optimal cage material is unknown. Cloward[15] advocated the use of ethylene oxide sterilized allograft bone. Brantigan chose carbon fiber–reinforced polymer because of its strength and because its modulus of elasticity is similar to that of cortical bone[44]. Commercially available cages are polyetheretherketone (PEEK), a nonreinforced polymer, and titanium, which has a modulus of elasticity signifcantly greater than that of cortical bone.

The technique requires adherence to the following 4 principles
1. Preserve the integrity of posterior motion segment that serves to stabilize and compress the cage.
2. Preserve the cortical endplates to avoid seating the cage in the soft cancellous bone of vertebralbodies.
3. Achieve maximal removal of discmaterial.
4. Fill the disc space with cage filled with autogenous graft.

SELECTION OF THE PATIENTS FOR SURGERY:
Inclusion
- All patients above with in age group of 15-75yrs diagnosed with degenerative spondylolisthesis, isthmic spondylolysis and spondylolisthesis
- All patients with minimal disc degenerative changes with preserved disc height
- Both sexes
- Patients with severe low back ache or severe symptoms of root compression who did not have relief of symptoms with conservative methods
- Patient diagnosed with both spondylolisthesis with failed conservativetreatment and consented for surgery.

***Exclusion criteria**
- Age less than 15yrs.
- Patient with local tissue condition making the surgery inadvisable
- Low back ache of less than 3 months duration, patients with

spondylolisthesis but with no clinical symptoms
- Patients with grade 5 spondylolithesis.
- Patients who did not have regular follow up of minimum 6 months.
- Patient with congenital spinal deformities.
- Patients who have had earlier spine surgeries.

PRE OPERATIVE RADIOGRAPHIC EVALUATION:
1. Lumbosacral spine including both hips- AP view and LATERAL view to know the level, grade of listhesis and lucencyin pars suggesting fracture
2. Flexion and extension views/Stress views of LS spine to determine the dynamic instability
3. MRI of LS SPINE to facilitate evaluation of root compression, disc changes and spinal cord compression

Operative technique
Anaesthesia:- General anaesthesia in supine position.
Position:-
Patient is then changed to prone position after the induction of anaesthesia with the bladder on catheter with two transverse pillows, one below the chest and the other underneath the pelvis so that abdomen is not compressed. Eyes are protected with cotton pads. Shoulders are placed in 60° abduction over the armboards. The patient is positioned in hyperextension to help create lumbar lordosis with the hip of two bolsters. The abdomen should hang free for unimpeded venous return; this decompresses the epidural venous plexus and helps reduce bleeding.

Image intensifier:-
They are used for the assessment of reduction of the slipped vertebra and of drilling trajectory.

Surgical approach
Operated area is cleaned and scrubbed thoroughly and draped. All surgeries were performed with absolute aseptic precautions by single senior orthopaedic surgeon in our operation theatre. In all cases a dose of intravenous antibiotic, cefuroxime was given 10 minutes prior to anaesthesia Through posterior midline approach, a 4-5 cm incision is given over corresponding vertebrae making sure that incision is extending one vertebrae above and below down to the fascia. Dissection is carried laterally superficial to the fascia on both sides about 4 cm for the length of the skin incision.

On each side of the midline make a 4 cm to 5 cm long fascial incision 3 cm off the midline at the approximate interval between the multifdus and longissimus

muscles, carry subperiosteal dissection laterally over the lamina at the L4, L5, and S1 levels remove the joint capsule.

Pedicle screw instrumentation:
Expose the transverse process of corresponding vertebrae and the sacral ala bilaterally if sacrum is needed to be fixed and prepare pedicle screw holes bilaterally, using fluoroscopy to assist in pedicle location and orientation. Guide wire was inserted at the infero lateral aspect of superior articular facet. Entry point was made easy by projecting the view of c-arm in AP plane and the trajectory of the wire was made easy by projecting the view of c-arm in lateral plane. Once position was confirmed, the guide was removed and the hole was enlarged with a pedicle probe with care not to penetrate the pedicle walls. All the 4 walls of the pedicle were then assessed with ball tipped probe for its intactness. The hole was then tapped with 5mm cancellous tap and 5mm pedicle screw as per length measured with guide wire assistance. Either mono axial or poly axial screw was inserted.The remaining three pedicle screws were inserted in the same manner and the position and length of the screws were confirmed with c-arm guidance facet.

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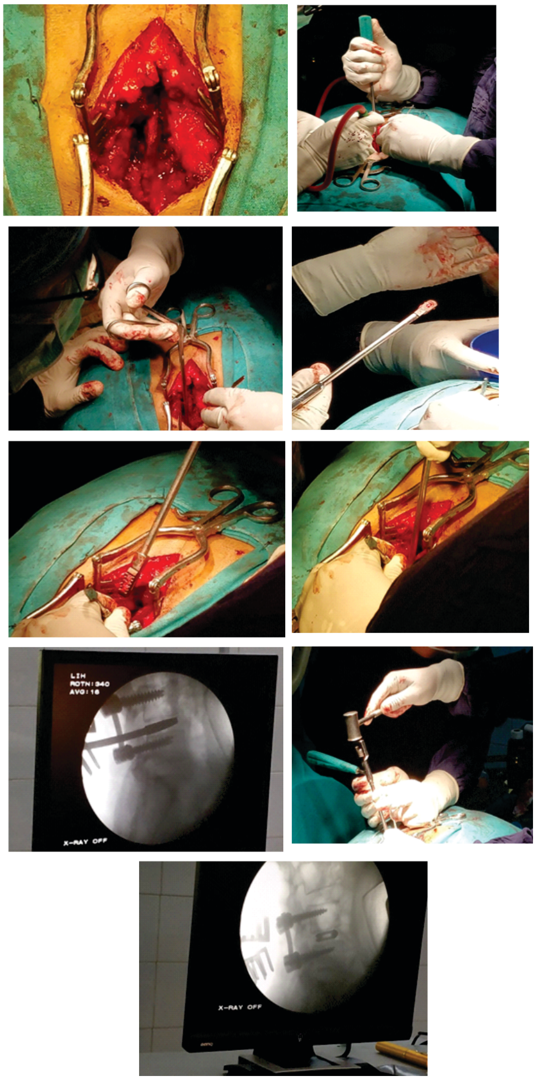
Prepare the S1 screw holes for a bicortical technique for enhanced screw purchase. Penetrate the sacral cortex medially at the promontory just caudal to the endplate. Sound each screw hole to ensure there are no cortical breaches and place a cottonoid for hemostasis.

Decompression

Posterior elements i.e.gills fragment is removed piecemeal en block and ligamentum flavum is detached to release fibrocartilagenous tissue at pseudoarthrosis site. Lamina is removed to free the existing nerve root from additional fibrocartilagenous tissue. Ligamentum falvum is detached at the

INTRA OPERATIVE PICTURES



caudal levels to free the traversing nerve root. Perineural adhesions if any present was also released. Mobility of the root was assessed under direct visualization. Fusion bed was then prepared by decorticating the transverse processes bilaterally at the level to be fused. Sacral ala was prepared if the level of fusion includes L5-S1. Care was taken to leave intact the immediate proximal functional joint foreg., we leave intact the L3-L4 facet capsule, supraspinous, infraspinous ligament between L3-L4 if the level of fusion was planned to be L4-L5. The morselized posterior elements were preserved as a graft source.

Cage placement and Reduction

MOSS Miami rod was bent to appropriate sagittal contours and was connected to the screw, first to the distal and then to the proximal screw. Temporary distraction was then done to create a adequate working window. Made a wideannulotomy is by retracting the thecal sacmedially. Wide annulotomy and discectomy is done to provide space for placement of cage. Wide exposure helps avoid traction injury to the lumbar roots, which can cause neuropathic pain and weakness. The annulus is opened bilaterally, and the disc space is distracted with intervertebral spreaders. They are inserted into the disc space horizontally and rotated 90 degrees, distracting the disc space. The disc is gradually distracted, working from side to side with increasingly large spreaders until resistance is met.After distracting the space to a comfortable working distance, usually 11 or 12 mm, one of the spreaders is removed, and a four-sided Collis curet 1 or 2 mm smaller than the largest spreader used is inserted horizontally, then rotated clockwise and counterclockwise to separate the cartilage from the bony endplate. A Kerrison rongeur is used to resect loosened annulus flush with the vertebral endplates; thisallows better visualization of the disc space so that a more complete discectomy can be done. Discectomy is completed with standard curets and pituitary rongeurs. After cleaning the interspace, the intervertebral spreader is reinserted, usually one size larger than was possible before removing the disc and cartilaginous endplate. The opposite side of the disc is now prepared in the same fashion. Goals of cage placement are to restore disc height and improve alignment with sufficient lordosis through the segment. Biomechanically, coverage of 35% of the endplate is desirable for stability. After ensuring that the dura and exiting nerve root are protected, a single expandable cage device packed with local autograft placed just anterior to the midbody is inserted horizontally into the disc space and then rotated into its final lordotic position. Once the device is transversely positioned, expand it to the predetermined desired height The intervertebral spreader is removed from the opposite side of the disc space. Release the distraction from the working rods.

The foramina and the midline under the dura are inspected to ensure no cancellous bone or disc material was displaced into the spinal canal or neural foramen. Place the final rods and apply mild compression for lordosis, being mindful of foraminal dimensions. Torque the set screws

Posterolateral arthrodosis

With the reduction complete, posterolateral grafting was done. We used morselized bone from the resected posterior spinal elements as the source.

A fluted drain (because of the exposed dura) is placed and close the fascia to the remaining spinous processes with interrupted sutures to restore the normal resting length of the muscle. Subcutaneous and subcuticularlayers are closed individually. Sterile compressive dressing is applied.

Patient turned onto the bed, awaken, and corresponding root function verified bilaterally by physical examination.

Postoperative management:

Patient is placed in supine position, and patient is given adequate analgesia for 48 hrs and drain in removed on 2^{nd} postoperative day. Intravenous antibiotics were used for 3 days, and then converted to oral antibiotics for another 3 days.

Patient is allowed to sit and walk on next day of surgery. The patient is mobilized without a brace. Regular dressings are done and sutures are removed on 10^{th} day. Patients are discharged with advice not to lift heavy weights for 6 months

Follow up examination:

Clinical assessment was done using pre and post operative improvement in SLRT, Neurogenic claudication, pain, neurological deficits.

Clinical assessment of functional activity by Oswestry disability index at 3, 6 and 12 months follow up and points were apportioned accordingly

Radiographs were also analyzed with reference to fusion, progression of slip at 1 months, 3months and 1yr.

Radiological analysis:

Post op X-rays are evaluated for

1. Signs of fusion
2. Progression of slip

Signs of fusion/union:

1. If there was no movement seen on the lateral view in the flexion extension in the fixed segment and
2. Continuity of the trabecular bone bridging at the fixed interbody space on the plain radiogram, it was termed ''union."

3. If there was any movement seen on the lateral view in the flexion-extension, it was termed "nonunion." It was said"probable union" if continuity of the trabecular bone bridging around the cage was vague in spite of no movement of the fixed segment

Progression of slip
1. slippage of more than 2mm on the lateral view at the fixed segment
2. Loss of correction was defined as an increase in kyphosis by greater than 3 degrees

Signs of stable fixation are
1. Fixation by bone ingrowth is defined as an implant with no subsidence and minimal or no radiopaque line formation around the cage and screws
2. Maintaining lumbar and segmental lordosis
3. An implant is considered to a have stable bony ingrowth when no progressive migration occurs
4. No collapse of space or cage subsidence into adjacent vertebral body or into the spinal canal.
5. No Screw loosening, defined as a radiolucency of 1mm or wider at the bone-screw interface.
6. No radiolucency or Cage loosening, defined as a radiolucency of 1mm or wider around the cage

Signs of unstable fixation
1. Posterior opening >5°; narrowing of the disc height <3 mm; progression of the slippage >3 mm.
2. Presence of radiolucency around cage and migration/subsidence of cage
3. Loss of continuity of trabecular bridging at the fixed interbody space
4. Loss of lumbar lordosis and segmental lordosis

OBSERVATION AND RESULTS
All 30 patients in the present study returned for clinical and radiological examinations subsequently. Patients were reviewed after 1months,3months,6months and 1year postoperatively. Radiographs were reviewed at end of 1months,3months and 1year

Observations in the form of tables, pie charts and bar diagrams are furnished

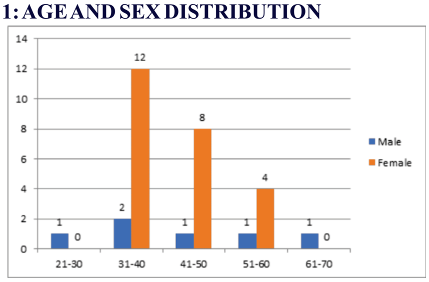
AGE DISTRIBUTION:
The age ranges from 21-63 years with mean age of 45.93 years. Most of the cases are between the age group of 40 to 50 years constituting 56.6% of study population

SEX DISTRIBUTION:
Of the 30 cases included in the study majority are female patients.24 patients are female constituting 80% of cases and the rest 6 are male patients constituting 20% of the cases

Table 1: AGE AND SEX DISTRIBUTION

	Male	Female	Total
21-30	1	0	1
31-40	2	12	14
41-50	1	8	9
51-60	1	4	5
61-70	1	0	1
	6	24	30

CHART 1: AGE AND SEX DISTRIBUTION



- 80% of study population were female
- Average age of patients in our study is 44.16 years
- Youngest patient who underwent surgery was 21years
- The oldest patient was 63 years

Table 2: SEX DISTRIBUTION

SEX	NO OF CASES	PERCENTAGE %
FEMALE	24	80%
MALE	6	20%

CHART 2: SEX DISTRIBUTION

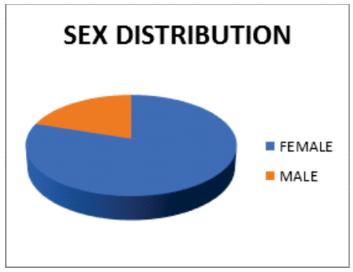
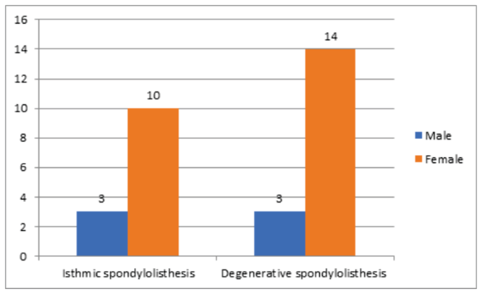


TABLE 3: TYPE OF LISTHESIS

Type of listhesis	Male	Female	Total
Isthmic	3	10	13
Degenerative	3	14	17
Total	6	24	30

CHART3: TYPE PF LISTHESIS

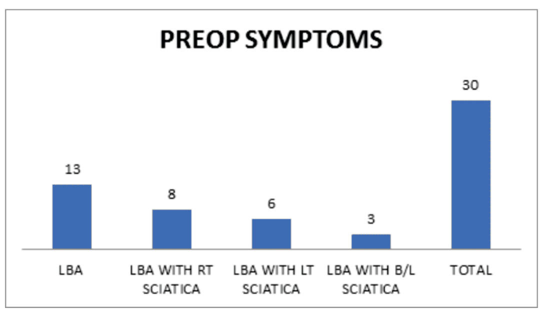


- 13 patients had isthmic spondylolisthesis out which 3 are male and 10 are femalei.e 43.33% of total study
- 17 patients had degenerative spondylolisthesis with 3 males and 14 females i.e 56.6% of total study
- Mean average age of isthmic spondylolisthesis patients are 36.61 years
- Mean average age of degenerative spondylolisthesis are 50.11

PREOPERATIVE SYMPTOMS:
TABLE 4: PREOPERATIVE SYMPTOMS

LBA	13
LBA WITH RT SCIATICA	8
LBA WITH LT SCIATICA	6
LBA WITH B/L SCIATICA	3
TOTAL	30

CHART 4: PREOPERATIVE SYMPTOMS



PREOPERATIVE NEUROLOGICAL DEFICITS:
TABLE 5: PREOPERATIVE NEUROLOGICAL DEFICITS

PREOP DEFICITS	NO OF PATIENTS	PERCENTAGE %
MOTOR & SENSORY	3	10%
MOTOR	10	33.3%
SENSORY	7	23.4%
NIL	10	33.3%
TOTAL	30	100

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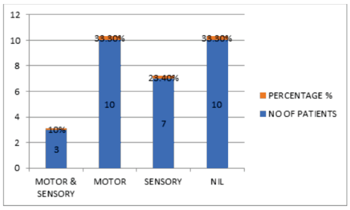
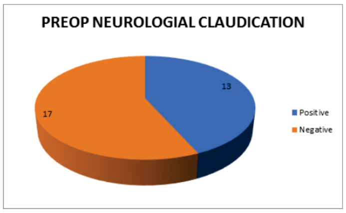
CHART 5: PREOPERATIVE NEUROLOGICALDEFICITS



PREOPERATIVE NEUROLOGICAL CLAUDICATION: TABLE 6

Preoperative neurological caludication	No of patients	Percentage %
Positive	13	43.4%
Negative	17	56.6%
Total	30	100%

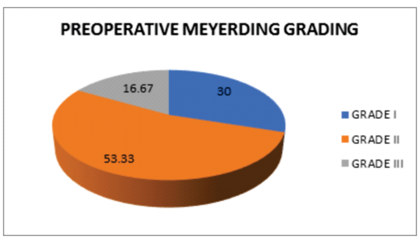
CHART 6: PREOPERATIVE NEUROLOGICAL CLAUDICA TION



PREOPERATIVE MEYERGIND GRADING
TABLE 7: PREOP MEYERDING GRADING

PREOP GRADING	NO OF PATIENTS	PERCENTAGE %
GRADE I	9	30
GRADE II	16	53.33
GRADE III	5	16.67
TOTAL	30	100%

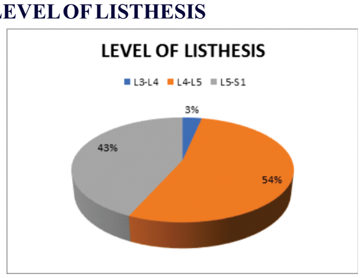
CHART 7: PREOPERATIVE MEYERDING GRADING



LEVEL OF SPONDYLOLISTHESIS
TABLE 8

LEVEL OF LISTHESIS	NO OF PATIENTS	PERCENTAGE
L3-L4	1	3.33%
L4-L5	16	53.4%
L5-S1	13	43.3%
TOTAL	30	100%

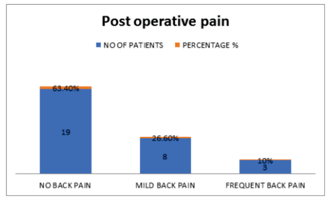
CHART 8: LEVEL OF LISTHESIS



POSTOPERATIVE SYMPTOMS
TABLE 9:

BACK PAIN	NO OF PATIENTS	PERCENTAGE %
NO BACK PAIN	19	63.4%
MILD BACK PAIN	8	26.6%
FREQUENT BACK PAIN	3	10%
TOTAL	30	100%

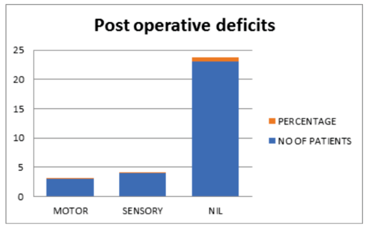
CHART 9: POSTOPERATIVE SYMPTOMS



POSTOPERATIVE DEFICITS:
TABLE 10: POSTOPERATIVE DEFICITS

	NO OF PATIENTS	PERCENTAGE
MOTOR	3	10%
SENSORY	4	13.4%
NIL	23	76.6%
TOTAL	30	100%

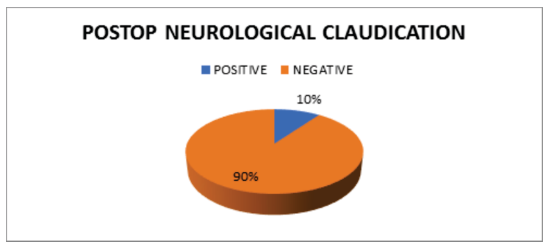
CHART10 : POSTOPERATIVE DEFICITS



POST OPERATIVE NEUROLOGICAL CLAUDICATION: TABLE 11 :

POSTOP NEUROLOGICAL CALUDICATION	NO OF PATIENTS	PERCENTAGE
POSITIVE	3	10%
NEGATIVE	27	90%
TOTAL	30	100%

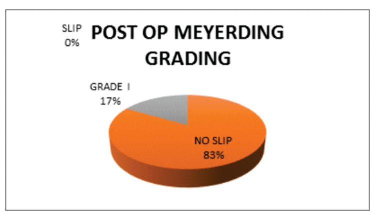
CHART 11



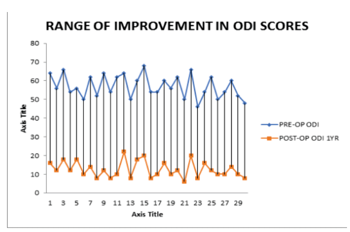
POST OPERATIVE MEYERDING GRADING
TABLE 12

SLIP	NO OF PATIENTS	PERCENTAGE
NO SLIP	25	83.4%
GRADE I	5	16.6%
TOTAL	30	100%

CHART 12:



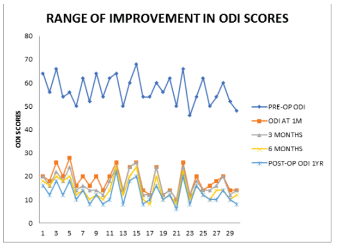
RANGE OF IMPROVEMENT IN ODI SCORES
CHART 13



- Average improvement of ODI scores was 44.47

RANGE OF IMPROVEMENT IN ODI SCORES AT EVERY FOLLOWUP:

CHART 14



CLINICAL OUTCOME

The average preoperative ODI score was 57. The ODI score at most recent follow up (1yr) was 12.53. The result was excellent in all cases improving from severe disability to minimal disability. Mean ODI at each follow up visit was compared with pre operative using Paired T test and p values were calculated. P value was found to be significant with each comparison.

TABLE 13: Statistics of preop& post op ODI scores comparison

	PREOP ODI	POSTOP ODI 1MONTH	POSTOP ODI 3MONTHS	POSTOP ODI 6MONTHS	POSTOP ODI 1YR
Mean Std.Deviation	57.000 6.0515	18.267 5.0850	16.800 4.7153	14.400 4.7387	12.533 4.3290

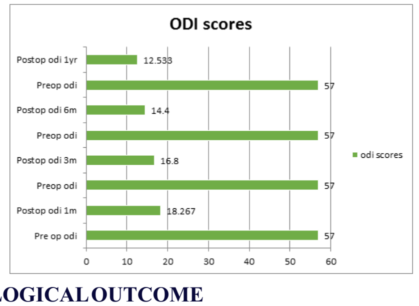
Table14 : paired sample statistics

	Mean	Std.Deviation	N	Std.Error Mean
Pre op ODI Postop ODI 1m	57.000 18.267	6.0515 5.0850	30 30	1.1048 0.9284
Preop ODI Postop ODI 3m	57.000 16.800	6.0515 4.7153	30 30	1.1048 0.8609
Preop ODI Postop ODI 6m	57.000 14.400	6.0515 4.7387	30 30	1.1048 0.8652
Preop ODI Postop ODI 1yr	57.000 12.533	6.0515 4.3290	30 30	1.1048 .7904

Table 15: paired samples correlation

	N	Correlation
Preop ODI Postop ODI 1m	32	.681
Preop ODI Postop ODI 3m	32	.667
Preop ODI Postop ODI 6m	32	.669
Preop ODI Postop ODI 1yr	32	.758

Chart15: Comparison of preop and post op ODI scores at every follow-up



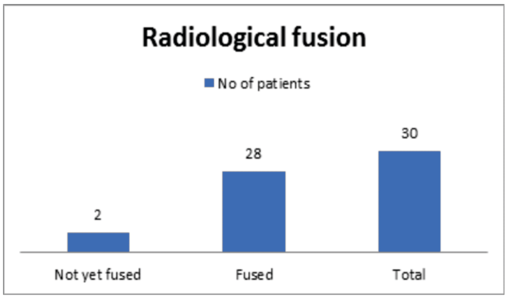
RADIOLOGICAL OUTCOME

Radiological evidence did not reveal any signs of cage subsidence or disc space narrowing or migration of cage

Table 16 : Achievement of fusion/union

	No of patients	Percentage
Not yet fused	2	6.66
Fused	28	93.33%
Total	30	100%

Chart 16:



Radiological union was defined as the presence of fusion mass which was usually seen in an average period of 8-12 months and we achieved union in all the 28 patients who turned up for review.

DISCUSSION

Conservative treatment has shown good results in spondylolisthesis cases. But recently patient life style and demands have shown more inclination towards surgery. The choice amongst surgical management is in debate now. PLF has

shown good results in many studies but has more post-operative problems. PLIF is more advantageous in these situations. The quality of life of the patient is significantly improved after surgery. The progressive vertebral slipping is also avoided

The mechanical instability in spondylolisthesis demands rigid fixation and solid fusion. Adequate decompression is the key factor in success. Rigid fusion between segments arrest further instability.Interbody fusion provides several advantages over other fusion techniques in treating spondylolisthesis. When the graft is placed at the weight bearing center of the spine where 80% of the axial load occurs. The disc height and the sagittal balance can be restored just as well as because optimal conditions are created for a higher fusion rate by placing the graft under compression with an extensive blood supply from the adjacent vertebral end plates. PLIF limits the extent of posterolateral soft tissue exposure, muscle stripping, and injury as well as allowing direct neural decompression.PLIF can be performed using either iliac bone graft or titanium cages however certain bone grafts tend to collapse and fracture. In addition the loss of disc space height after insertion of these bone grafts had been identified because the compressive strength of the grafts does not exceed the physiologic compressive loads of the spine

In cage fusion the amount of bone required for graft is significantly reduced. The cage design allows bone growth through and around it. When used in conjunction with a rigid posterior instrumentation system, the MOSS MIAMI system was effective in significantly increasing the initial stiffness of the fused segment above all other constructs[46,47,48,49,50,51]

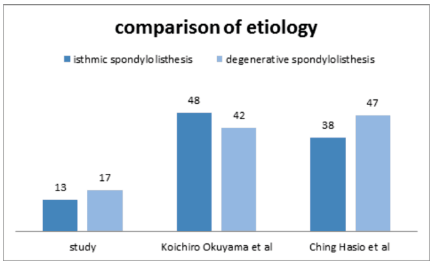
Our study is a prospective study comprising of 30 patients with surgical management in Spondylolisthesis treated with pedicle screw fixation And posterior lumbar inter body fusion. Of the 30 cases included in the study majority do females (24) constitute 80% of cases and the rest 6 are male patients constituting 20% of the cases. The mean age of the patients in the group is 44.16 years (range from 21-63 years) which is similar to study done by Rolemberg Dantas et al[52] there were 20 females and 10 males with mean age of 46.7 years and Jie Zhao et al[16] who reviewed 27 patients and average age of patients was 46years

Table 18: Mean age and comparison with other studies

Study	Mean age 44.16 years
Dantas et al	Mean age 46.7 years
Jie Zhao et al	Mean age 46 years

Out of 30 patients included both adult isthmic spondylolisthesis i.e 13 patients(3 male and 10 female)and degenerative spondylolisthesis i.e 17 patients (3 male and 14 female). Female preponderance was noted in degenerative spondylolisthesis which was similar to other study done by Ki-Tack Kim et al [26] and Ching Hasio et al[17] in which they included spinal conditions with degenerative spondylolisthesis in 47 patients (62%) and isthmic spondylolisthesis in 29 patients (38%)

Chart 18: COMPARISON OF ETIOLOGY



Average age of patients in isthmic spondylolisthesis was 36.61 years and 50.11 years in degenerative spondylolisthesis which was comparable to the study done by Mususlman et al[30], Jie Zhao et al[16] and Ki-Tack Kim et al[26]. in our study isthmic spondylolisthesis patients are relatively younger which attributed to early identification and patients had more deficits compared to other studies where as patients with degenerative spondylolisthesis showed similar age group trends compared to other studies.

CHART 19: COMPARISON OF MEAN AGE FOR IS

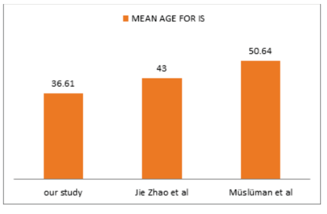
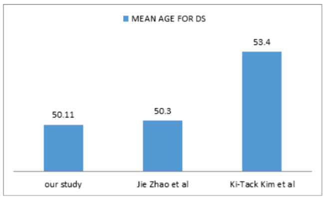


CHART 20: COMPARISON OF MEAN AGE FOR DS

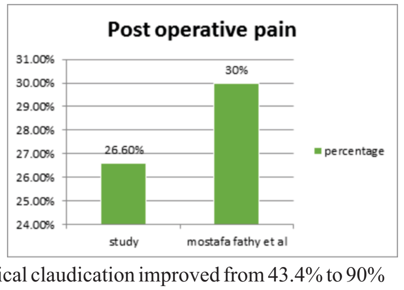


Clinical outcome:

A sound fusion is often believed to be a prerequisite for clinical success in patients with mechanical low back pain.

In our study there is a significant improvement in clinical outcome i.e 19 patients (63.4%) of patients had no residual back pain, 8 patients (26.6%) suffered low back pain for 2-3 months postoperatively compared to 30% of patients according to Mostafa Fathy et al[46]. This pain was managed by using non steroidal anti-inflammatory drugs together with physiotherapy with a favorable response.3 patients had frequent back ache which got worsened at last follow-up which might be attributed to decreased muscle strength postoperatively due to excessive muscle stripping

CHART 21: comparison of post operative pain with other study



Neurological claudication improved from 43.4% to 90%

Out of 30 patients 10 % had both motor and sensory deficits immediately after surgery with complete recovery postoperatively. 3 (10%) patients had motor weakness which was explained by neuropraxia associated with nerve root traction and had improved with conservative management , 4(13.3%) patients had sensory weakness this may be explained by extensive exposure of the exiting nerve root following facetectomy, with postoperative improvement in 3 patients which were treated with medication and physiotherapy which gradually improved the neurological status and 1 patient had did not improve symptomatically.

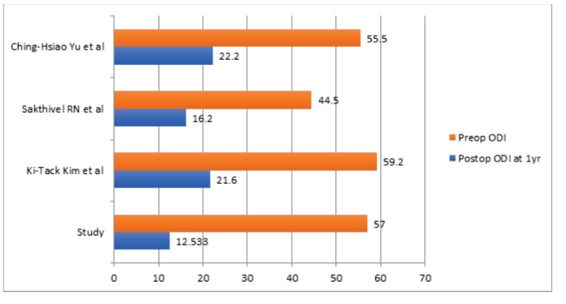
The mean Oswestry disability score(ODI) preoperatively was preoperatively 57(range 46-64) which was similar to mean preoperative ODI score in study done by Ki-Tack Kim et a[26]in 48 patients preoperative ODI was 59.2

A prospective controlled study of Lei Cheng et al[53] between January 2001 and May 2003, 68 patients were operated on with pedicle screw fixation and posterior lumbar interbody fusion (PLIF). In the PLIF group preoperative mean Oswestry score was 31.3 (16–80), Sakthivel RN et al[31] evaluated 42 patients with lumbar spondylolisthesis with moderate to severe low back pain and/or sciatica, whose mean ODI was 44.5 (range, 26-67), Ching-Hsiao Yu et al[17] evaluated functional outcome in spondylolisthesis patients treat with instrumented PLIF in 31 patients whose preoperative ODI 55.5 ± 14.5. Our study preoperative ODI score was similar to Ching-Hsiao Yu et al[17], Ki-Tack Kim et al[26].

Table 19 COMPARISION OF ODI SCORES WITH VARIOUS STUDIES

Study	Preop ODI	Postop ODI at 1yr
Study	57	12.533
Ki-Tack Kim et al	59.2	21.6
Sakthivel RN et al	44.5	16.2
Ching-Hsiao Yu et al	55.5	22.2

Chart 22: COMPARISION OF ODI SCORES WITH VARIOUS STUDIES



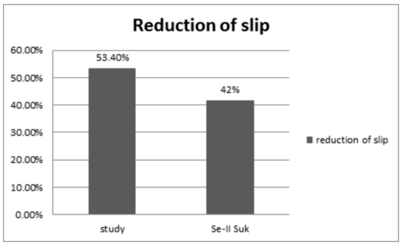
Postoperative ODI score at 1 yr follow up was 12.533 in our study which was low compared to other studies and there was significant improvement post-operatively from severe disability to minimal disability which is highly statistically significant with p value less than 0.05. this significant reduction in post operative score is due to less adjacent segment degeneration found in plif as it adds additional stability in anterior segment of spine thus decrease in low back ache and improving functional status.

Radiological outcome:

In the present series out of 30 patients majority of patients had GRADE II of Meyerding grading i.e 16 patients(53.3%), 9 patients had GRADE I and 5 patients had GRADE III, out of which majority were present at L4-L5 ,level there was a great significance in slip reduction i.e53.4% of slip reduction.

5 patients ended up with residual GRADE I slip. Se-II Suk[20] retrospective study analyzing 76 patients treated by decompression, pedicle screwinstrumentation, and underwent posterior lumbar interbody fusion. Reduction of slippage was 28.3% in those who underwent posterolateral fusion and 41.6% in those who had posterior lumbar interbody fusion (P< 0.05)in our study there is greater reduction of slippage indicating.Cages maintained the corrected sagittal alignment of the lumbar spine better than bone graft alone. Correction in segmental lordosis was maintained with cage. Hence artificial cages provide better functional and radiographic outcomes than only bone chips in PLIF for lumbar spondylolisthesis. Maintenance of lordosis and sagittal realignment during fixation is necessary to decrease adjacent segment degeneration which can be achieved through plif which was proven in our study.

CHART 23: COMPARISON OF REDUCTION OF SLIP WITH OTHER STUDY

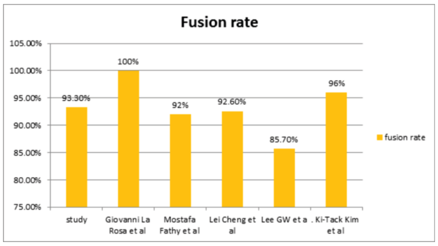


Fusion rate

Radiological fusion was confirmed in 30 patients by the end of 1yr followup. we achieved union in all the 28 patients who turned up for review. According to Giovanni La Rosa et al[54] 17 consecutive patients underwent pedicle screw fixation and PLIF for isthmic spondylolisthesis fusion was achieved 100% fusion was achieved. Outcome of instrumented lumbar fusion for low grade spondylolisthesis for evaluation of interbody fusion with cages by Mostafa Fathy et al[46] in 50 consecutive patients in whom surgery was performed between June 2000 to June 2003. Fusion rate of total of 25 patients operated for PLIF using titanium cages, 23 patients (92%) were radiographically shown to have good fusion. solid fusion was achieved in 63 of 68 (92.6%) patients in the PLIF group by Lei Cheng et al[53]

Lee GW et al[55] reported fusion rate was similar between PLF and PLIF: fusion occurred in 84.6% (33/39) in group PLF and 85.7% (36/42) in group PLIF at 1 year after surgery. Ki-Tack Kim et al[26] noticed 96% fusion rate in PLIF group at 1 yr follow up.

Chart24: COMPARISON OF FUSION RATES WITH OTHER STUDIES



Our study showed superior fusion rates compared to other studies which was statistically significant. Higher fusion rate in pedicle screw fixation and PLIF was obtained due to strong posterior construct which transmits loading axis through posterior column and disc height is maintained which in turn maintain saggital balance of spine leading decreased adjacent segment degeneration.

Placing cage in the intervertebral cancellous bed of the vertebral body enhances higher fusion rate and stabilization. Cage made of titanium alloy has more affinity to bone tissue and improves bone in growth around the alloy allowing rapid healing and spinal stability

Pedicle screw fixation and PLIF that attributed to higher fusion rate in our study are due to the following factors

1. Single incision
2. Correction and maintenance of lumbar lordosis, hence decreases adjacent segment degeneration
3. Correction of percentage of slip
4. Restoration of load-bearing capacity to the posterior spinal column
5. Promoting and maintaining disc space height
6. Biomechanically ideal and enhances osteosynthesis and spinal arthrodesis superior compared to posterolateral fusion with or without instrumentation in lumbar degenerative diseases
7. Using threaded titanium cage enhances more solid stiffness and rigid construct

The patients in our study were followed up for an average period of 16.8 months.In the period that we followed the patients and we did not encounter any construct failure such as pedicle screw breakage, cage migration/subsidence,loosening, or fractures. Out of 30 cases in our study 28 patients showed good union and 2 patients had probable union which might be attributed to high stiffness of titanium cage and posterior construct which were similar to the results of Koichuro Okuyama et al[25],29 (93.5%) of 31 operated segments achieved union and 2 (6.5%) had probable union.

Outcome assessed as excellent, good, fair or poor. Excellent and Good outcomes were considered satisfactory; fair or poor outcomes were considered unsatisfactory.

Outcome was assessed according to the following criteria:

- Radiologically demonstrated fusio
- Clinical improvement of pain and level of activity
- Active employment status at the time of follow-up.

TABLE 20: SURGICAL OUTCOME OF THE STUDY

outcome	No of patients	
Excellent/good	25	Satisfactory
Fair	5	Unsatisfactory
Poor	0	

At the time of follow-up visit, 83.3% of the patients operated with titanium cages were satisfied with the results of the surgery superior to the results found from other groups i.e by Mustafa Fathy et al[46].

CHART 25: SURGICAL OUTCOME OF THE STUDY

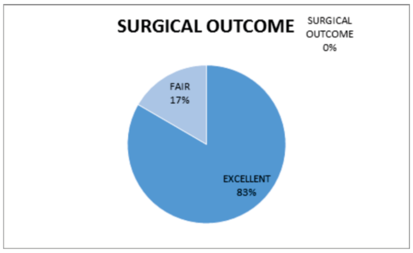
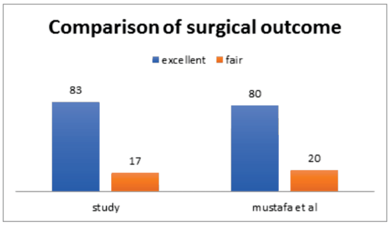


CHART 26: COMPARISON OF SURGICAL OUTCOME

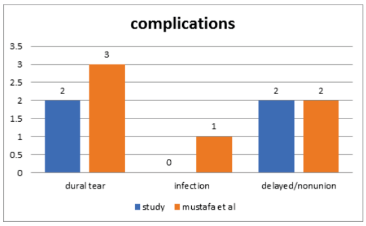


Satisfactory fusion was obtained at all levels at a minimum one year follow up. The fusion rate was 93.3% higher fusion rates and a better clinical outcomehasbeen obtained by Instrumented PLIF with titanium cages.

Inderbody fusion cages help to stabilize spinal segment primarily by distracting them as well as by allowing bone in growth and fusion. The procedure is safe and effective with 93.3% fusion rate and 83.3% overall Satisfactory rate.

Complications:

CHART 26: COMPARISON OF COMPLICATIONS WITH OTHER STUDY



There were no serious systemic complications or deep surgical site infections which might probably be due to the strict sterile technique followed preoperatively and postoperatively. No immediate postoperative neurological complications were observed, although an incidental dural tear was observed in two patients (6.7%) This can be attributed to more required space for placement of the titanium cages that necessitates more dural traction. No cage subsidence/migration, pedicle screw fractures, loosening or pseudoarthrosis or revision are noticed in our study which was achieved through good surgical skill and technique.

LIMITATIONS:

The limitation in our study is a relatively short follow up and therefore, we could not come to a conclusion about the late complications and long term results of pedicle screw fixation and PLIF. We have used only Oswestry Disability Index to assess the pain, function and mobility

CONCLUSION

Although this study is limited byfew numbers of patients and the duration of follow up is very short, the outcomes suggest that the management of spondylolisthesis can beaccomplish edsucce ssfullywith pedicle screw fixation and PLIFtechnique. The outcome showed high fusion rate and excellent clinical outcome in terms of pain relief and functional capabilities. Patients are satisfied with results and most of them resumed their normal activities and are pursuing their routine work. Although in some patients there are minor residual symptoms but they did not limit the activity. Complications encountered in our short term follow-up did not affect the outcome at the end. Neither the complications like cage subsidence nor construct failure have not been found in our study, nor analysis regarding survivorship and longevity of PLIF and pedicle screw fixation has been dealt with. Long term follow up is mandatory to analyze these aspects. In conclusion, we would suggest PLIF technique supplemented with posterolateral fusion is an ideal technique in spondylolisthesis for the achievement of

1. Reduction and maintenance of lordosis
2. Direct decompression of nerve roots
3. Interbody fusion
4. Good biomechanical support by pedicle screw instrumentation and cage

Our study supports the usage of pedicle screw fixation and PLIF in both isthmic and degenerative spondylolisthesis. With current trend, research and advent to new implants support PLIF in patients suffering with severe disability due to spondylolisthesis.

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