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Single Level Degenerative Lumbar Spondylolisthesis - Clinicoradiological Outcome of Treatment with Posterior Fusion with Instrumentation and Bone Graft (A Prospective Observational Study)

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Abstract: ***This single centre prospective observational study was aimed to investigate the clinicoradiological outcomes of posterior lumbar interbody fusion (PLIF) using autogenous bone graft and single segment instrumentation with pedicle screws in single level lumbar degenerative spondylolisthesis. The outcomes were measured using visual analogue scale (VAS), Oswestry disability index and Prolo Functional Economic Rating. Radiological outcome was measured using Brantigan fusion grading and modified Lee's classification. All patients with age group greater than 50 years with single level degenerative lumbar spondylolisthesis of any grade and unresponsive to conservative management for 3 months were included in this study. The current study showed good symptomatic relief of symptoms and solid bony fusion in patients with single level degenerative spondylolisthesis using above mentioned procedure.***

Keywords: Degenerative lumbar spondylolisthesis, PLIF, Oswestry disability index, VAS

1.Introduction

Low back pain constitutes one of the largest medical and socio-economic problems in today's society. Anywhere between 60 to 90% of people in India [1-3] are affected with LBP at some point of time in their lives. One of the causes of back pain, spondylolisthesis, occurs in approximately 5% of the population. In a study, When CT scans of the abdomen were performed for an unrelated reason, it was revealed that nearly 5.7% of the population have spondylolysis and nearly 3.1% have spondylolisthesis. Spondylolisthesis is found to be two to five times more frequent in patients with low back pain.

Spondylolisthesis is derived from greek word "spondylos" (vertebra) and "olisthesis " (to slip or fall). Spondylolisthesis is defined as the forward slippage of a cephalad vertebra on a caudal vertebra. This most commonly occurs at the lumbosacral junction, but it can occur at higher levels as well.

It is classified on the basis of etiology into the following five types[4]:

1. Congenital or dysplastic
2. Isthmic
3. Degenerative
4. Traumatic
5. Pathologic

Degenerative spondylolisthesis (DS) is a frequently observed spinal disorder in motion segments. [5-6] The unique features of DS are long-standing degeneration with dysfunction of the intervertebral discs and loss of facet joints posteriorly. [7] It seldom occurs before the age of 50 years and is approximately four times more prevalent in women than in men.

Many cases can be managed conservatively. However, in patients with incapacitating symptoms, radiculopathy, neurogenic claudication, postural or gait abnormality resistant to non-operative measures, and significant slip progression, surgery is indicated. The goal of surgery is to stabilize the spinal segment and decompress the neural elements if necessary.

Posterior lumbar interbody fusion (PLIF) is traditionally indicated in wide range of lumbar spinal pathologies including patients with degenerative segmental instability. PLIF has many advantages over other forms of stabilization and fusion.[8]

The current study focused on the results of one of the modalities of treatment of symptomatic lumbosacral spondylolisthesis, viz. instrumented fusion using autogenous bone graft in single level lumbar degenerative spondylolisthesis in the Indian population. Here we attempt to discuss the merits of this procedure and evaluate the results of the same and compare our results with those of others.

The objectives of the present study were to prospectively assess the clinicoradiological outcome in posterior lumbar interbody fusion using autogenous bone graft and single segmentation instrumentation with pedicle screws in single level lumbar degenerative spondylolisthesis.

2.Aim and Objectives

Aim:

Clinicoradiological outcome in posterior lumbar interbody fusion using autogenous bone graft and single segmentation instrumentation with pedicle screws in single level lumbar degenerative spondylolisthesis-a prospective study.

Primary Objective:

The primary objective was assessment of LBP after surgery at varied intervals at 3 months, 6 months and 1 year during follow up visits using the Visual Analogue Scale (VAS). Intensity of pain was rated on the range of 0 mm (no pain) to and 100 mm (extreme pain) (10 cm). Before surgery, all patients were instructed about use of the VAS.

Secondary Objectives:

Functional assessment was measured using Oswestry disability index and Prolo functional economic rating scale [9]at subsequent follow ups.

Radiological outcome: Fusion was assessed using Brantigan fusion grading criteria [10] and Modified Lee's Classification[11].

Complication rate- Implant failure, neurological complications, wound infection.

Comparison of results with that in the literature.

3.Material and Methods

Study Site:

The study was conducted at the Department of Orthopedics, SSSIHMS-Prasanthigram, Puttaparthi, Andhra Pradesh, India, a three hundred bedded tertiary care referral super specialty teaching hospital in South India.

Study Population

All patients who underwent instrumented spinal fusion were selected based on the inclusion criteria mentioned below.

Sample Size: 50

Study Design: Prospective Observational Study

Time Frame: 2 years (June 2018 to June 2020)

Inclusion Criteria:

- Patients of age group > 50 years.
- Patients with single level degenerative lumbar spondylolisthesis of any grade.
- Patients unresponsive to conservative management for a minimum of 3 months and qualify for posterior lumbar interbody fusion for single level.
- Patients giving a valid written/informed consent for the study.

Exclusion Criteria:

- Patients with congenital/traumatic/pathological lumbar spondylolisthesis.
- Patients with multiple level lumbar spondylolisthesis.
- Patients with previous lumbar spine surgery.
- Patients not willing for follow up.

Assessment and Pre-Operative Work-Up

Patients initially presented in the out-patient department. They were evaluated by the resident and the consultant at the time and scheduled to be seen in the spinal clinic accordingly. All patients then underwent clinical assessment at spinal clinic and neurological charting was done. Imaging studies were conducted including standard antero-posterior and lateral radiographs, oblique radiographs of lumbosacral spine to look for the defect in pars interarticularis and flexion-extension views to note the dynamic translation. MRI was done for all the patients to evaluate the neural elements and compression.

Subsequently a trial of conservative treatment for a variable period followed; our protocol in these cases consisted of a minimum period of 3 months of exercises for strengthening core back and abdominal muscles, stretching exercises for hamstrings, NSAIDs and limitation of activity. Instability, radiculopathy, neurological deficits, persistence of pain and significant limitation of daily activities after the trial of conservative measures were taken as indicating the necessity for surgery. Patients were further evaluated by MRI and/or CT scans to look for evidence of disc pathology, nerve root compression, changes in facet joints, pedicle architecture and for planning of surgery. Routine pre-operative blood work is done in all patients

Post-Operative Follow-Up

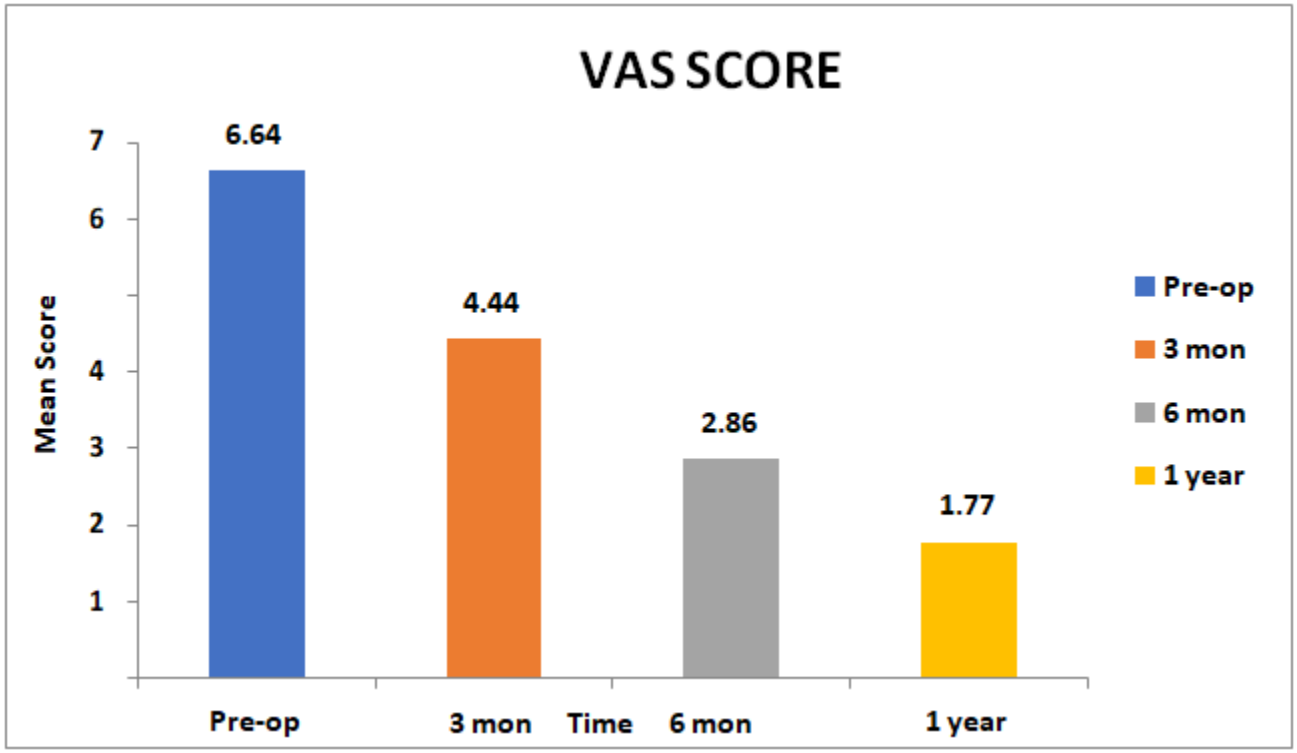
All patients were followed up at regular intervals post-operatively: starting from the 2nd week post-operatively for suture removal; 6th week; 3rd month, 6th month and 1 year. At every follow- up neurological assessment, clinical assessment, assessment of pain, activity restriction and radiological assessment was done. The VAS score for LBP was the primary outcome measure used. Pre-operative measurements were corroborated with post-operative measurements and compared to study the effectiveness of surgery.

4.Results and Observation

Table 1: Comparison of VAS score for LBP between different time intervals

Vas	N	Mean (SD)	Range	Median (Q1- Q3)	Friedman Test	
					Chi square value	p-value
Pre-op	50	6.64 (1.10)	4- 8	7 (6- 7.25)	142.83	<0.001 *
3 mon	50	4.44 (1.59)	1- 8	5 (4 - 5.25)		
6 mon	50	2.86 (1.71)	0- 6	3 (1- 4)		
1 year	50	1.77 (1.47)	0- 4.5	2 (0- 3)		
Improvement	50	4.87 (1.34)	2 - 8	4.75 (4 – 6)		

All pairwise comparison statistically Significant
*p<0.05 statistically significant, p>0.05 non-Significant

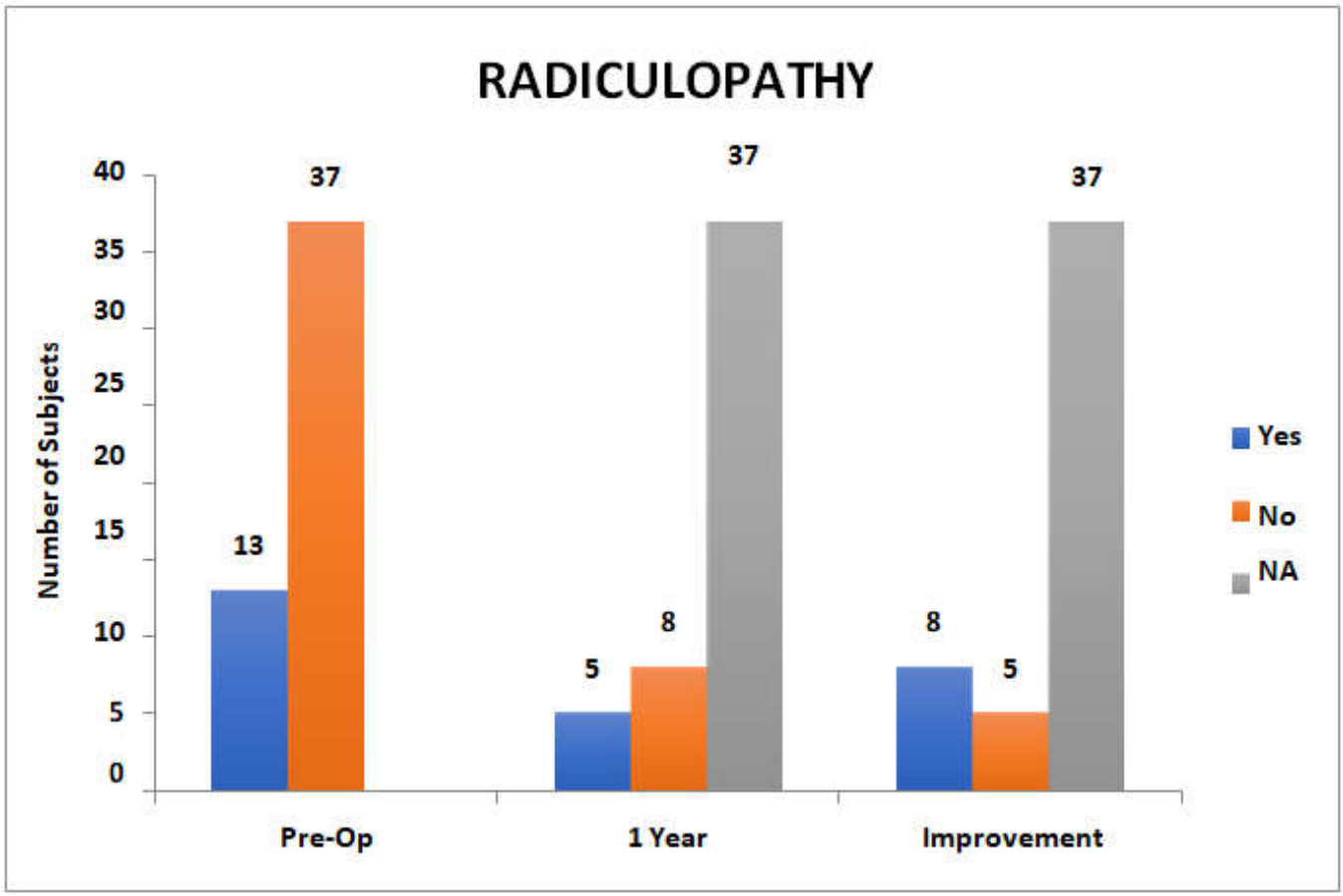


Graph 2: Distribution of study participants according to VAS score

We used VAS score for rating the intensity of pain. The mean Vas score preoperatively was 6.64 and at the end of 1-year mean VAS score was 1.77 with an improvement of 4.87. This was statistically significant with a p value of <0.001.

Table 2: Distribution of the study participants according to Radiculopathy

RADICULOPATHY		Frequency	Percent
Pre-Op	Yes	13	26.0
	No	37	74.0
1 year	Yes	5	10.0
	No	8	16.0
	NA	37	74.0
Improvement	Yes	8	16.0
	No	5	10.0
	NA	37	74.0



Graph 3: Distribution of study participants according to radiculopathy

Thirteen patients had radiculopathy preoperatively. Out of these eight patients showed improvement at the end of 1 year postoperatively.

Table 3: Distribution of the study participants according to Level Of Spondylolisthesis

	Frequency	Percent
L4-L5	45	90.0
L5-S1		10.0

L4-L5 was the most common level involved (90%). L5-S1 was involved in 10% of the patients.

Table 4: Presentation of Meyerding Grade at pre operatively and post operatively

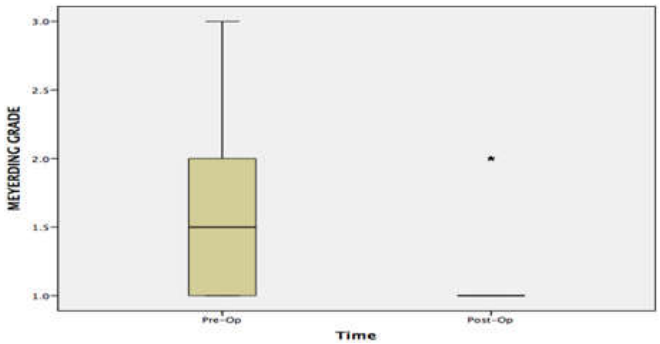
Meyerding Grade	Pre-Op		Post Op	
	Frequency	Percent	Frequency	Percent
1	25	50.0	42	84.0
2	23	46.0	8	16.0
3	2	4.0	0	0.0

As per Meyerding grade of spondylolisthesis, 50% of the patients had Grade 1, 46% had Grade 2 and 4% had Grade 3 spondylolisthesis preoperatively. Postoperatively, 84% had Grade 1 and 16% had grade 2 spondylolisthesis.

Table 5: Comparison of Meyerding Grade pre operatively and post operatively

Meyerding Grade	N	Mean (SD)	Range	Median (Q1-Q3)	Wilcoxon Signed Ranks Test	
					z	p-value
Pre-Op	50	1.54 (0.58)	1- 3	1.5 (1- 2)	-4.36	<0.001*
Post Op	50	1.16 (0.37)	1- 2	1 (1- 1)		

*p<0.05 statistically significant, p>0.05 non-Significant



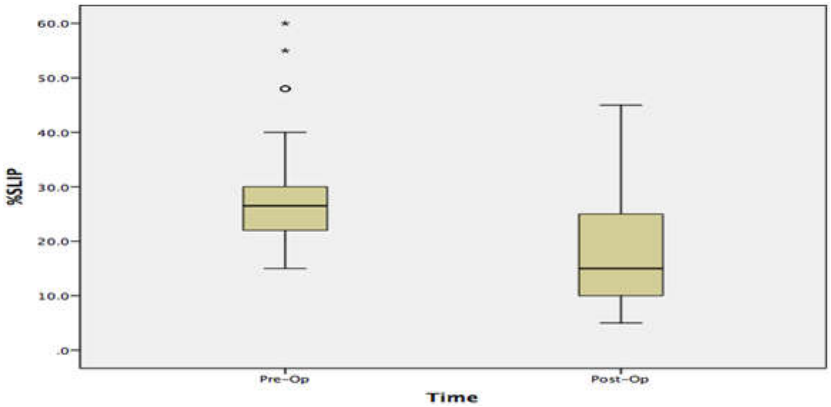
Graph 5: comparison of Meyerding grade pre operatively and post operatively

Mean Pre-op Meyerding grade was 1.54 and at the end of 1 year postoperatively it dropped to 1.16 which was statistically significant with a p value of <0.001.

Table 6: Comparison of Slip percentage pre operatively and post operatively

	N	Mean (SD)	Range	Median (Q1-Q3)	Wilcoxon Signed Ranks Test	
					Z	p-value
Pre-Op	50	28.82 (10.61)	15- 60	26.5 (21.5-32.5)	-6.12	<0.001*
Post Op	50	17.88 (9.35)	5- 45	15 (10- 25)		

*p<0.05 statistically significant, p>0.05 non-Significant



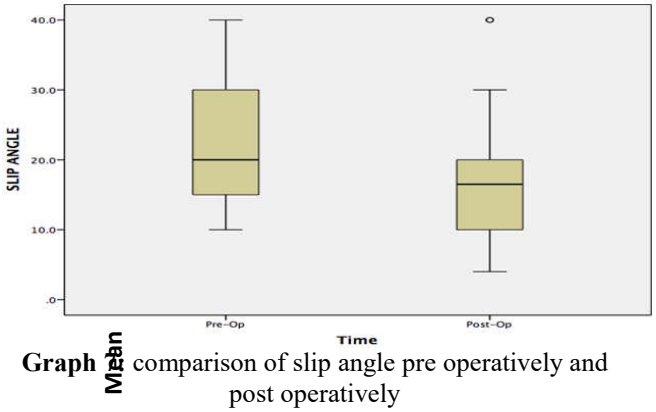
Graph 6: Comparison of slip percentage pre operatively and post operatively

Mean percentage of slip preoperatively was 28.82 +/-10.61 which dropped to 17.88 +/- 9.35 postoperatively at the end of 1 year with a statistically significant p value of <0.001.

Table 7: Comparison of Slip Angle pre operatively and post operatively

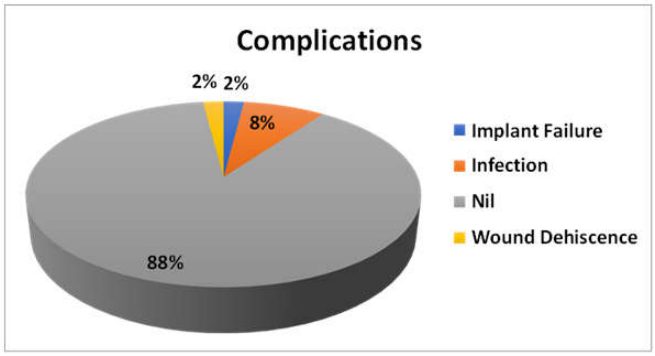
	N	Mean (SD)	Range	Median (Q1-Q3)	Wilcoxon Signed Ranks Test	
					z	p-value
Pre-Op	50	23.54 (9.12)	10- 40	20 (15- 30)	-4.72	<0.001*
Post Op	50	17.48 (8.44)	4- 40	16.5 (10- 20)		

*p<0.05 statistically significant, p>0.05 non-Significant



Graph 7: comparison of slip angle pre operatively and post operatively

Mean Slip angle preoperatively was 23.54 +/-9.12 and postoperatively at the end of 1 year it dropped to 17.48 +/- 8.44 with a significant p value of <0.001.



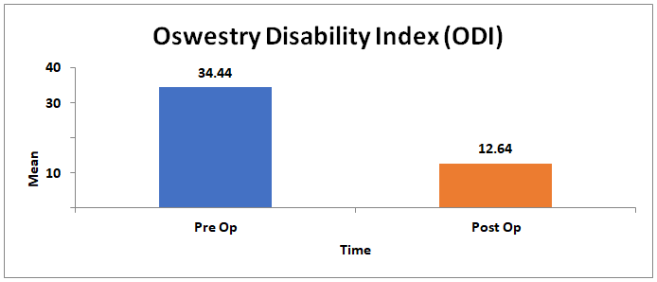
Graph 8: Percentage distribution of study participants according to complications

The main complication in our study was, infection in 8% (n=4) of the patients. We had one case each of implant failure and wound dehiscence.

Table 12: Comparison of Oswestry Disability Index (ODI) score between pre operatively and post operatively

	N	Mean (SD)	Range	Median (Q1-Q3)	Wilcoxon Sign Rank Test	
					z	p-value
Pre Op	50	34.44 (6.09)	20 - 52	34 (30- 38)	- 6.22	<0.001*
Post Op	50	12.64 (4.59)	3 - 20	12 (8 - 16.5)		
Improvemen	50	21.80 (5.58)	4 – 34	22 (22 – 24)		

Paired t test
*p<0.05 statistically significant, p>0.05 non significant

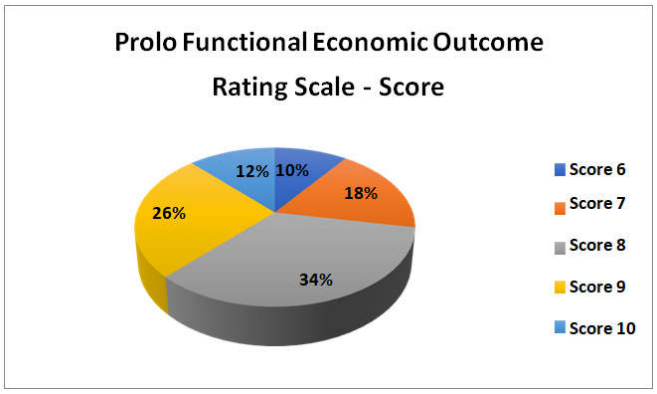


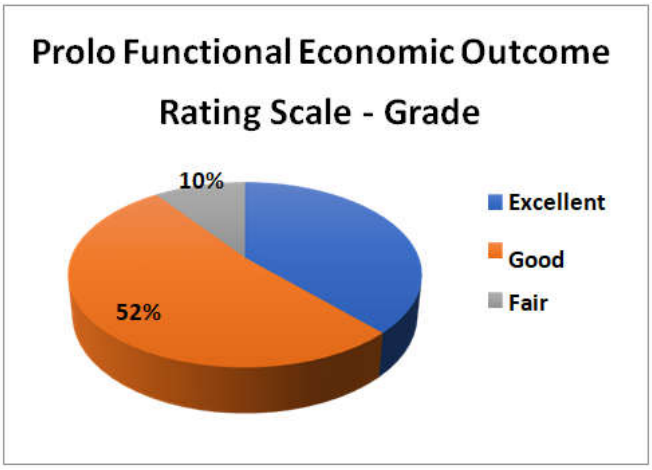
Graph 9: Comparison of ODI score preoperatively and postoperatively

Preoperative ODI score was 34.44 +/-6.09 and at the end of 1 year postoperatively it dropped to 12.64 +/- 4.59, an improvement of 21.8+/- 5.58. It was statistically significant with p value of <0.001.

Table 13: Prolo functional economic rating scale- score and Grade

Prolo Functional Economic Outcome Rating Scale		Frequency	Percent
Score	6	5	10.0
	7	9	18.0
	8	17	34.0
	9	13	26.0
	10	6	12.0
Grade	Excellent	19	38.0
	Good	26	52.0
	Fair	5	10.0



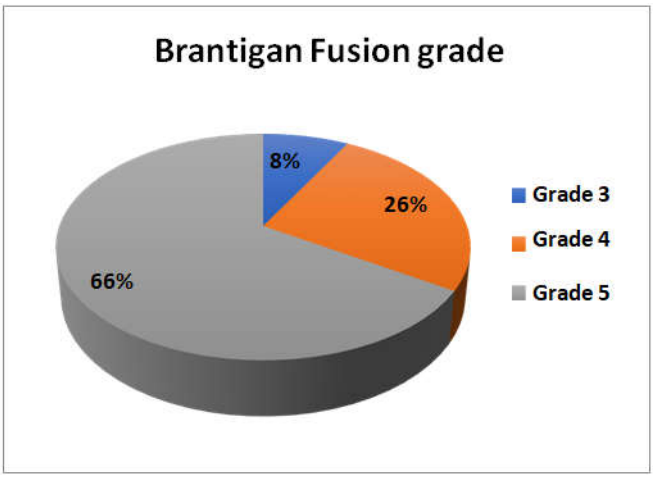


Graph 10 and 11: percentage distribution of study participants according to prolo functional economic rating scale outcome.

Postoperatively at the end of 1 year, 38% of patients had excellent, 52% had good and 10% had Fair outcome.

Table 14: Brantigan fusion grade

	Grade	frequency	percentage
BRANTIGAN fusion grade	3	4	8.0
	4	13	26
	5	33	66



Graph 12: percentage distribution of study participants according to brantigan fusion grade

Postoperatively at the end of 1 year 8% of patients had Grade 3 of Brantigan fusion, 26% had Grade 4 and 66% had Grade 5 fusion.

Complications

The main complication in this study was infection in 8% (n=4) of the patients. One case of wound dehiscence and one case of implant failure, screws losing purchase in the pedicles at 1 year follow up. For wound dehiscence, thorough wound wash and debridement was done in operation theatre followed by sterile dressing. The debrided tissue was sent for culture and sensitivity and empirical antibiotic coverage was given. Culture came out to be negative. After 3 days wound was reassessed in operation theatre, inflammation had subsided and wound was healthy, therefore secondary suturing was done. Follow up was satisfactory. Three of the infected cases were successfully treated by debridement and specific antibiotic therapy for 2 weeks since it had involved only subcutaneous tissue. The fourth one needed surgical revision checking since it had affected superficial muscular fascia along with subcutaneous tissue. Since deeper tissues were normal, implant was not removed. Culture yielded Pseudomonas species and was treated successfully by intravenous antibiotics. The implant failure did not warrant removal as the patient did not have any functional disability.

5.Conclusion

Pedicle screw fixation with interbody fusion as a fusion procedure provided several advantages like increase in the fusion rate, allowed early mobilization of patients and obviated the need for heavy orthoses in the post-operative period.

Instrumented PLIF in situ with posterior decompression significantly reduces pain and functional disability and gives good fusion rates.

Irrespective of the duration of symptoms, all patients achieved symptomatic relief, suggesting that solid bony fusion of the listhetic segment is the treatment of choice for symptomatic relief in terms of low back and leg pains.

The degenerative spondylolisthesis has female preponderance with commonest segment affected is the L4-L5 followed by L5-S1.

There is no correlation between duration of symptoms, age of the patient at the time of presentation and pre-operative VAS score for LBP. Also, there is no correlation between improvement in ODI score, age of patient at the time of presentation and preoperative VAS score. It was statistically not significant.

There is no correlation between slip percentage, age of the patient and duration of symptoms at the time of presentation. There is no correlation between slip percentage and improvement in ODI score postoperatively. Also there is no correlation between slip percentage and VAS score for LBP preoperatively. It was statistically not significant.

PLIF in situ with transpedicular instrumentation along with posterior decompression is safe and effective

procedure and achieves good functional outcome at early and midterm follow-up.

References

[1] Rubin DI. Epidemiology and risk factors for spine pain. Neurologic clinics. 2007; 25: 353–371.
[2] Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain: frequency, clinical evaluation, and treatment patterns from a US national survey. Spine. 1995; 20: 11– 19.
[3] Andersson GB. Epidemiology of low back pain. Acta Orthopaedica Scandinavica. 1998; 69: 28–31.
[4] Wiltse LL, Newman PH, Macnab IAN. Classification of Spondyloisis and Spondylolisthesis. Clinical Orthopaedics and Related Research (1976-2007). 1976; 117: 23–29.
[5] Chen Q, Cao L, Bian C, Wang H-R, Lin H, Li X-L, et al. Degenerative Spondylolisthesis in the Fifth Lumbar Vertebra and Radiographic Parameters. Clinical spine surgery. 2017; 30: E1233–E1238.
[6] Kitchen WJ, Mohamed M, Bhojak M, Wilby M. Neurogenic claudication secondary to degenerative spondylolisthesis: is fusion always necessary? British Journal of Neurosurgery. 2016; 30: 662–665.
[7] Guha D, Heary RF, Shamji MF. Iatrogenic spondylolisthesis following laminectomy for degenerative lumbar stenosis: systematic review and current concepts. Neurosurgical focus. 2015; 39: E9.
[8] Hee HT, Castro Jr FP, Majd ME, Holt RT, Myers L. Anterior/posterior lumbar fusion versus transforaminal lumbar interbody fusion: analysis of complications and predictive factors. Clinical Spine Surgery. 2001; 14: 533–540
[9] Prolo DJ, Oklund SA, Butcher M. Toward uniformity in evaluating results of lumbar spine operations. A paradigm applied to posterior lumbar interbody fusions. Spine. 1986; 11: 601–606.
[10] Fogel GR, Toohey JS, Neidre A, Brantigan JW. Fusion assessment of posterior lumbar interbody fusion using radiolucent cages: X-ray films and helical computed tomography scans compared with surgical exploration of fusion. The Spine Journal. 2008; 8: 570–577.
[11] Lee CK, Vessa P, Lee JK. Chronic disabling low back pain syndrome caused by internal disc derangements: the results of disc excision and posterior lumbar interbody fusion. Spine. 1995; 20: 356–360

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