

COMPARISON OF OUTCOME IN LUMBAR ISTHMIC SPONDYLOLISTHESIS TREATED SURGICALLY WITH PEDICLE SCREW FIXATION WITH AND WITHOUT INTER BODY FUSION DEVICE (CAGE)

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ABSTRACT

Background: Lumbosacral spondylolisthesis is the forward translation of the fifth lumbar vertebra (L5) over the first sacral vertebra (S1). Treatment options include any one of the following techniques such as decompression, posterolateral fusion with or without instrumentation, and interbody fusion. All these have produced different degree of success and had their own share of complications.

Objectives: 1. To establish the outcome functionally and radiologically and compare the results after fixation of the listhesis with pedicle screw with interbody fusion device i.e; cage or with bone grafting alone.

2. To estimate the duration taken for fusion 3. To evaluate the post operative fixation failures and complications.

Materials and method: This is a non-randomised prospective study of patients with lumbar isthmic spondylolisthesis. 20 patients in total were examined and assessed from December 2019 to June 1st, 2021. The research was carried out in the Department of Orthopaedics at Narayana Medical College and Hospital in Nellore

Results: Among the 20 patients, there are 7(35%) males & 13(65%) females. Coming to the Bone Graft group there are 4 (40%) males and 6 (60%) females. Among the cage group, there are 3 (30%) males and 7 (70%) females. The VAS scale (0-10) was used to assess pain decrease in both groups following surgery at pre-op, 6 weeks, 3 months, six months, and one year.. After surgery, both groups exhibited statistically significant improvement in disability on the ODI scale (0-100) after 6 weeks, 3 months, 6 months, and 1 year. Comparing the pre-op Benzel's Modified Japanese Orthopaedic Association Scale (0-18) with postop scores, both groups demonstrated significant improvement in performing activities of daily living after 6 weeks, 3 months, 6 months, and 1 year.

Conclusion:Instability is common in the fourth decade of life, having female predominance and the most commonly the instability is at L5-S1.PLIF with Cage is procedure is having increased operational time and less blood loss.Patients with PLIF + Cage showed better neurological improvement, pain reduction, decreased disability, overall satisfaction as apparent by Benzel's modified Japanese orthopaedic association scales, Visual Analogue Scale , Oswestry Disability Index, and SF-36 scores accordingly, which is however not significant.PLIF with cage is related with lesser post operative morbidity, better motor improvement, less paraesthesia & increased Straight Leg Raise Test.After 1 year,the fusion rate of PLIF with Cage is 100% and 90% with Bone graft alone which is not significant.

Keywords: Lumbar Isthmic Spondylolisthesis, Pedicle Screw Fixation, surgical outcome, Interbody fusion device.

INTRODUCTION:

The condition known as spondylolisthesis was given its name by combining two Greek words: spondylo, which means spine, and listhesis, which means to slide. This condition is characterised by an anterior slippage of the cephalad vertebrae in relation to the caudal

vertebrae in the surrounding area. In the year 1782, Herbineaux, an obstetrician from Belgium, was the first person to identify it.¹

Kilian first described spondylolisthesis in 1854.²The contraction of the muscles that are posteriorly located erector spinae, in conjunction with the force of gravity pressing on the upper body mass via the lordotic lumbar spine and the lumbosacral junction, is the biomechanical force that is creating this translation. The anteriorly directed vector is caused by this contraction.³

The anatomical components that normally resist this anteriorly directed strain must fail for spondylolisthesis to develop. Some examples of these structures include the facets, the annulus fibrosus, the posterior bony arch, and the pedicles.⁴

The intensity of slips ranges from I to V, with I being the least severe. Slips of a high grade and/or instability call for surgical intervention. Several different types of treatments have been proposed, some of which include instrumented reduction and fusion (with or without a cage) performed using the following procedures:

1. Anterior Lumbar Interbody Fusion (ALIF)
2. Posterior Lumbar Interbody Fusion (PLIF)
3. Trans-foraminal Lumbar Interbody Fusion (TLIF)
4. Extreme Lateral Interbody Fusion (XLIF)
5. Posterolateral Interbody fusion (PLF)
6. Oblique lumbar Interbody fusion
7. Circumferential Fusion⁵

All of them have resulted in varying degrees of success, as well as their fair share of complications. We assessed the effects of PLIF with pedicle polyaxial screws and interconnecting rods along with interbody fusion cage filled with one's own bone graft for intervertebral fusion and functional outcome. Now-a-days, PLIF is gaining popularity. It is often used to treat spondylolisthesis, degenerative disc disease, and recurrent disc herniations .

The vertebral bodies sustain 80 percent of the body weight, whereas the posterior segments support 20 percent of the body weight. Fusion of the anterior body with a cage and bone graft, as well as the posterior segments with screws and rods, aids in the circumferential stabilization and the stability is considerably superior to pedicle fixation alone.

AIMS AND OBJECTIVES

1. To establish the outcome functionally and radiologically and compare the results after fixation of the listhesis with pedicle screw with interbody fusion device i.e; cage or with bone grafting alone.
2. To estimate the duration taken for fusion
3. To evaluate the post operative fixation failures and complications

MATERIAL AND METHODS

This is a non-randomised prospective study of patients with lumbar isthmic spondylolisthesis. 20 patients in total were examined and assessed from December 2019 to June 1st, 2021. The research was carried out in the Department of Orthopaedics at Narayana Medical College and Hospital in Nellore .

The criterion for which instrumentation was required to restore spine stability has established the rationale for surgery as isthmic spondylolisthesis was producing instability. Fusion was recommended in situations of severe back pain and radicular pain in patients who had no response to conservative therapy. All the patients were first evaluated in the outpatient department and received a detailed neurological examination; radiographs were collected, and therapy was administered in accordance with the particular treatment plan.

INCLUSION CRITERIA:

1. The research will involve patients with lumbar isthmic spondylolisthesis.
2. Patients aged 18 and above will be involved in the trial.
3. Patients suffering from worsening neurological impairment
4. Patients suffering from severe neurogenic claudication
5. For at least 6 months, having no response to conservative treatment.

EXCLUSION CRITERIA:

1. Patients with uncontrolled co-morbid disorders are deemed unsuitable for surgery.
2. Patient suffering from spinal abnormalities, polio, and cerebral palsy.
3. Patient suffering from a localized or systemic infection.
4. Previous attempt of interbody fusion at the same level.
5. Pregnancy and breast-feeding mothers.
6. Immunodeficiency diseases.
7. Patients suffering from congenital, traumatic, or dysplastic spondylolisthesis

PRE-OPERATIVE WORK UP:

- Informed and written consent.
- History.
- To determine the reason of the instability, a local and systemic clinical examination have to be performed.
- The SF-36 Bodily Pain Score , Visual analogue scale, Oswestry Disability index and Benzel's modified Japanese orthopaedic association scale will be used to evaluate pain and instability clinically and radiologically.⁶
- Radiographic examination using radiographs (AP, lateral, and flexion extension radiographs), CT scan, and MRI.
- Baseline and other necessary investigations
- Clinical and radiological diagnosis
- Surgery - Posterior approach with pedicle polyaxial screw fixation with (cage) or with bone grafting alone will be properly informed before the surgery and will be performed as such.
- Criteria for choosing an interbody fusion device (cage) will be at the discretion of the operating surgeon.

Statistical analysis:

Quantitative data will be given as mean+/-SD, and significant mean differences were determined using a test called one-tailed student's T test.

Qualitative data will be reported in the form of percentages & Chi-square test with age adjustment was used to determine significance.

Schedule of Data collection

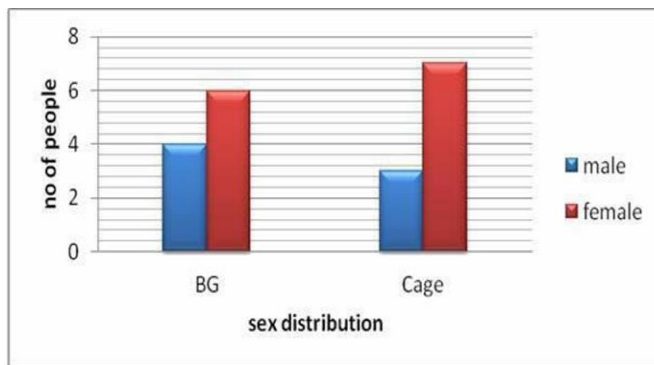
SCHEDULE OF DATA COLLECTION						
EVALUATION	Pre-op	Post-op	6 weeks	3months +	6months	1 year
Straight A-P & Lateral radiographs	+	+	+			
T2 weighted MRI/ CT	+					+
Lateral extension flexion	+				+	+
Neurological examination	+	+	+	+	+	+
SF-36	+		+	+	+	+

Data forms	VAS	+	+	+	+	+	+
	ODI	+		+	+	+	+
	Mod. Benzel's Japanesescal	+	+	+	+	+	+

Results

We divided participants into two groups on the basis of surgeon's preference: the Bone graft group is having (n = 10) and the cage group is having (n = 10). We employed the use of local host bone chips for PLIF of BG group and cages filled with morselized bone chips in the Cage group.

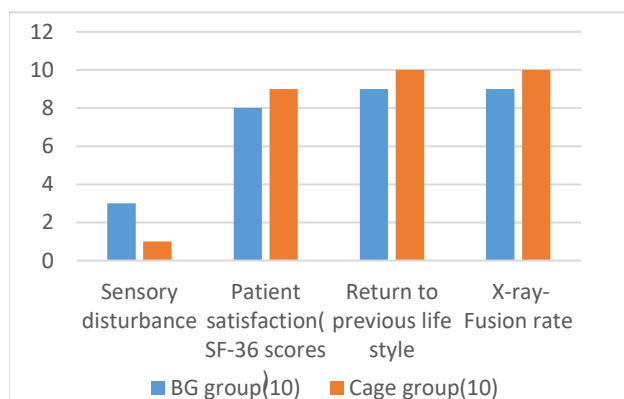
1. Distribution of age and gender:



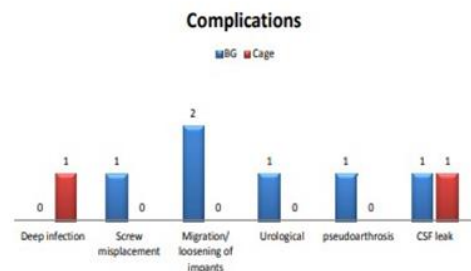
2.Instability level :

Level	Bone Graft	Cage	Total
L1-L2	0	0	0
L2-L3	0	0	0
L3-L4	0	0	0
L4-L5	4	1	5
L5-S1	6	9	15

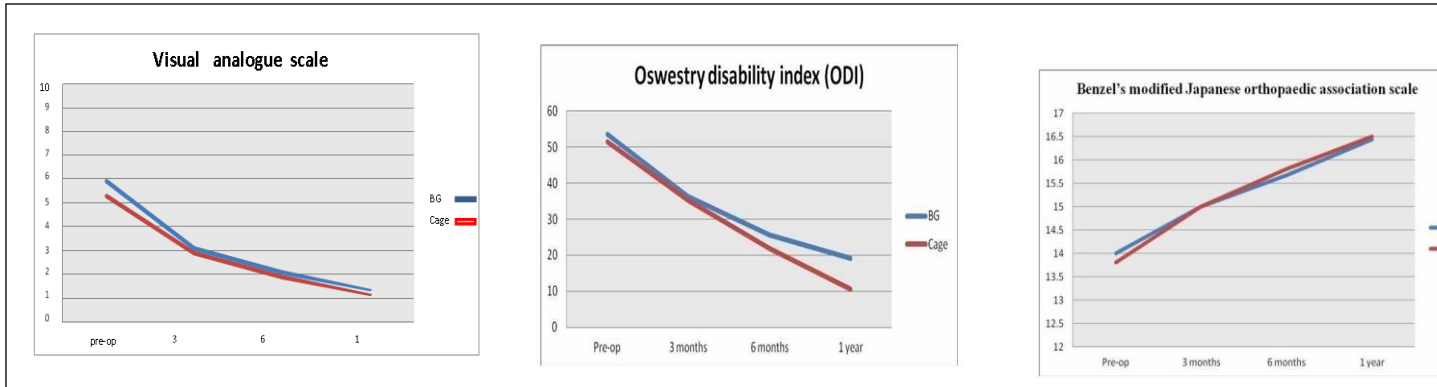
3. Clinical and Radiological outcome:



4.COMPLICATIONS



5.Functional result :



1. Among the 20 patients, there are 7(35%) males & 13(65%) females. Coming to the Bone Graft group there are 4 (40%) males and 6 (60%) females. Among the cage group, there are 3 (30%) males and 7 (70%) females.
2. We had 15 (75%) L5-S1 instability and 5 (25%) L4-L5 instability among the patients of our series.
3. The motor recovery was smooth in all patients, with 30% paresthesia in the Bone Graft group and 10% paresthesia in the Cage group. All patients in the Bone Graft group, with the exception of one (ten percent), returned to their previous disability-free lifestyle.

Fusion rates in the BG group were 0 percent, 30 percent, and 90 percent at 3 months, 6 months, and 1 year, respectively, whereas they were 0 percent, 50 percent, and 100 percent in the Cage group

4. Intraoperative problems like bleeding and nerve root damage. Total six complications (30%) occurred in the study. In the cage group, there is 1 (5%) a deep infection that has subsided by treating with antibiotics. In the BG group, 2 (20%) cases had implant loosening at 3 months & 1 (5%) had nonunion along with worsening of stress urinary incontinence after surgery. Among both the groups, there was one (10%) occurrence of intra-operative CSF leak.
5.
 - A. The VAS scale (0-10) was used to assess pain decrease in both groups following surgery at pre-op, 6 weeks, 3 months, six months, and one year. However, there is no substantial difference in between the Bone Graft and Cage groups.
 - B. After surgery, both groups exhibited statistically significant improvement in disability on the ODI scale (0-100) after 6 weeks, 3 months, 6 months, and 1 year. There is, however, no substantial difference between the Bone Graft and Cage groups.
 - C. Comparing the pre-op Benzel's Modified Japanese Orthopaedic

Association Scale(0-18) with postop scores, both groups demonstrated significant improvement in performing activities of daily living after 6 weeks, 3 months, 6 months, and 1 year. There is, however, no substantial difference between the Bone Graft and Cage group.

Discussion:

Successful spondylolisthesis surgery requires identifying patients with substantial lumbar canal stenosis, assessing listhesis level and grade, determining if the cage is needed, and ensuring stability and fusion after surgery.

The most controversial aspect of spondylolisthesis surgery is late segmental fusion and late work resumption.

It was found that isthmic spondylolisthesis mostly affects the L5-S1 junction. Our research showed that medicinal care, antilordotic support, and other conservative management failed patients over 6 months, requiring surgery.

VAS , and ODI showed considerable functional improvement and pain reduction after surgery. The meta-analysis by Yong-Ping and colleagues supported this. Our study found that PLIF with cage improves patient satisfaction and stability and allows patients to resume activities sooner than other fixation methods, making it the preferred surgery for low-grade spondylolisthesis, contrary to Yong Ping and colleagues' meta-analysis, which found a long-term outcome.⁷

Another fascinating debate is whether spinal instrumentation improves spondylolisthesis surgical results. Pedicle screw fixation of plates or rods improves adult fusion rates most. In 83 instances, Deguchi found that stiff pedicle screw fixation had a high fusion rate for multilevel spinal fusion in isthmic spondylolisthesis, while rigid or semi-rigid instrumentation was equally effective for single-level fusion.⁸

In 2008, Cheng et al. observed no statistically significant improvement in disability scores after 4 years of follow-up in 138 patients, unlike our findings. ⁹Similar to Ching-Hsiao Yu et al., our cage group had superior radiological fusion than the bone transplant group.¹⁰

Briggs and Milligan invented PLIF in 1944 using laminectomy and bone chips in disc space for interbody transplant.¹¹ Jaslow afterwards placed a removed spinous process into intervertebral space.¹²

Cloward popularised Impacted Iliac crest graft in 1953 with positive results.¹³

PLIF achieved 85% fusion rates despite its technical difficulty. Graft extrusion, dural damage, nerve injury, arachnoiditis, and blood loss are its issues. Once installed, the cylinders provide amazing fixation. Since the cage restricts vertebral motion, this relieves back pain quickly. High fusion rates have been seen. Traditionally, fusion rates were 60-70% without cages. The cage fusion rate is estimated to be above 90%.

The cages are also useful because the bone transplant is in smaller pieces. Our research had its own challenges but showed great fusion rates and early clinical improvements in PLIF with cages.

PLIF reduces neurogenic pain from dura/nerve root compression and stabilises the spine in deformity and degeneration.¹⁴

Conservative therapy was initially used for low back pain, radiating lower

limb discomfort, neurologic claudication from spondylolisthesis or degenerative spinal canal stenosis.

Most individuals without neurodeficiency progress with conservative treatment. Only when these symptoms prevent the patient from performing daily tasks. Surgery (PLIF) was the best option.¹⁵

Our study also included people who had failed conservative therapy and were severely impaired with the above symptoms.

Posterolateral fusion caused muscle fibrosis due to excessive relaxation of muscles along the transverse process, increased blood loss, and delayed wound healing. Inter body fusion had higher fusion rates, less transverse muscle relaxation, and early stabilisation like PLIF with pedicular screws. After decompressing only the affected side in a single cage, our patients' symptoms and disability improved over time, as demonstrated by outstanding Modified Oswestry scores.

Local bone eliminates the need to collect iliac bone, which reduces surgical time and blood loss, but in our research it is not significant.

Cage plus bone grafting had higher fusion rates than autologous bone grafting alone, however the difference was not statistically significant after 1 year.

Cage patients had better clinical outcomes, as shown by follow-up exams and grading.

Whether local bone is an alternative to iliac bone transplantation is still debated since there are no prospective randomised control studies comparing fusion rates using long-term longitudinal radiographic evaluation.

The interbody spacer is crucial to early fusion stability. The model's axial stiffness was almost unchanged when the spacer was shifted posterior, despite greater fusion volume.

Instrumentation and cages pose neighbouring segment degeneration risks. Instrumentation and cages increase stability and fusion rates.

Today, interbody fusion is the preferred treatment for lumbar spinal issues such as discogenic pain. CT is better at assessing fusion progression and status than dynamic radiography.

CT is better than plain radiography for evaluating fusion in metallic or non-metallic interbody cages, according to several studies. Even while thin-section helical CT is the best way to diagnose bone bridging, it may overestimate its incidence if done early after surgery.¹⁶

Therefore, we used conventional CT to analyse the Fusion in our prospective trial.

Mishra SK et al studied Comparison of outcome in lumbar spine instability treated surgically with pedicle screw fixation with or without interbody fusion device (cage), he concluded that Addition of an interbody fusion device (Cage) helps in greater stability, lower implant failure, higher fusion rate and better functional outcome in patient treated with PLIF for lumbar spine instability.¹⁷

CONCLUSION

In the functional and radiological outcome assessment of PLIF with Cage or with Bone graft alone in instability of Lumbar spine,

1. We conclude that the instability is common in the fourth decade of life, having female predominance and the most commonly the instability is at L5-S1.
2. PLIF with Cage is procedure is having increased operational time and less blood loss.
3. Patients with PLIF + Cage showed better neurological improvement, pain reduction, decreased disability, overall satisfaction as apparent by Benzel's modified Japanese orthopaedic association scales, Visual Analogue Scale, Oswestry Disability Index, and SF-36 scores accordingly, which is however not significant.
4. PLIF with cage is related with lesser post operative morbidity, better motor improvement, less paraesthesia & increased Straight Leg Raise Test.
5. After 1 year, the fusion rate of PLIF with Cage is 100% and 90% with Bone graft alone which is not significant.
6. Complication rates were sixty percent in bone graft group and twenty percent in cage group, with overall complication rate being forty percent.

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