



## A FUNCTIONAL AND C.T GUIDED FUSION ANALYSIS FOR LUMBAR SPONDYLOLISTHESIS TREATED WITH POSTEROLATERAL FUSION AND PEDICLE SCREW FIXATION

### ORTHOPAEDICS

**Dr. P. Sankaralingam** Associate professor, Department of ORTHOPAEDICS, Meenakshi medical college hospital and Research Institute, Kanchipuram, Tamilnadu, India.

**Dr. D.Venkatesh** Senior resident, Department of ORTHOPAEDICS, Meenakshi medical college hospital and Research Institute, Kanchipuram, Tamilnadu, India.

**Dr. R.V. Adhiyamaan** Senior resident, Department of ORTHOPAEDICS, Meenakshi medical college hospital and Research Institute, Kanchipuram, Tamilnadu, India.

### KEYWORDS:

#### INTRODUCTION

Lumbar spinal instability caused by Spondylolisthesis is a very common disease entity seen in day to day orthopaedic practice. Spondylolisthesis defined as anterior or posterior slipping of one segment of the spine on the next lower segment. Spondylolisthesis usually involves a bony defect in the pars interarticularis.

Currently a variety of techniques are available for lumbar fusion<sup>2</sup>. The operative options for Spondylolisthesis varied and include the following:

1. Posterior in situ fusion
2. Adding instrumentation to a posterior in situ fusion
3. Posterior decompression, partial reduction, instrumentation and fusion
4. Posterior decompression, complete reduction, instrumentation and posterior fusion
5. Posterior fusion with postoperative cast reduction
6. Anterior release
7. Intradiscal graft or structural cage combined with posterior instrumentation and fusion
8. Reduction and circumferential fusion with or without instrumentation.
9. Posterior instrumentation and fusion combined with posterior/transforaminal lumbar interbody fusion.

In general, there are two main approaches to spinal fusion, a surgery designed to stop low back pain caused by painful motion of the vertebrae. One of the main differences between these two approaches is where the bone graft is laid in the spine to form the fusion<sup>3</sup>.

#### MATERIAL AND METHODS

The present study entitled "functional C.T guided fusion analysis of lumbar spondylolisthesis treated with posterolateral fusion and pedicular screw fixation" was undertaken to assess the outcome of the aforementioned surgery and for which the following methods were used.

#### STUDY SETTINGS:

The present study was undertaken in the Department of Orthopedics at Meenakshi Medical College Hospital and Research Institute, Enathur, Karrapettai Post, Kanchipuram – 631561, Tamilnadu, India.

#### STUDY UNIVERSE:

The study universe consists of "Adults with Spondylolisthesis" and Spondylolisthesis is defined as anterior or posterior slipping of one segment of the spine on the next lower segment. Spondylolisthesis usually involves a bony defect in the pars interarticularis

#### STUDY UNIT:

"Individual adult with spondylolisthesis"

#### INCLUSION CRITERIA:

1. Spondylolisthesis causing lumbar spine instability.
2. Patients aged more than 18 years and less than 60 years
3. Failure of conservative management.

#### EXCLUSION CRITERIA:

1. Patients with other spinal deformities, polio, cerebral palsy and other generalised bone disorders.
2. Patients with systemic infection, previous interbody fusion at target level.
3. Pregnancy and lactation.

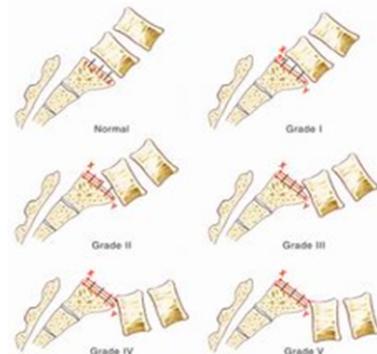
#### DEPENDENT VARIABLES:

- Slip score

The Meyerding grading system is the most commonly used grading system for spondylolisthesis. The slip grade is calculated by determining the ratio between the anteroposterior diameter of the top of the first sacral vertebra and the distance the L5 vertebra has slipped anteriorly.

Grade I	displacement of 25% or less
Grade II	25% - 50%
Grade III	50% - 75%
Grade IV	more than 75%

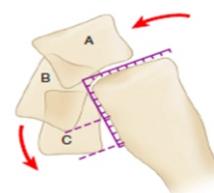
Grade V is termed as Spondyloptosis, which means the L5 has completely slipped over the S1.



#### Modified Newman spondylolisthesis grading system

The dome and the anterior surface of the sacrum are divided into ten equal parts. Degree of slip is measured by two numbers –

- One along sacral end-plate
- Second along anterior portion of sacrum

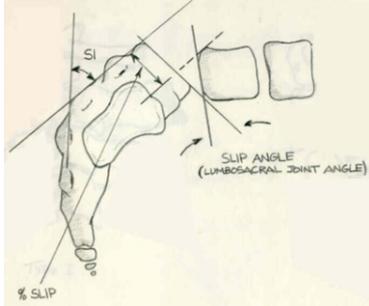


Bone scan may be used in difficult cases to identify the pars defect. If there is increased uptake, CT may be done to get further details.

MRI provides the greatest assistance in obtaining intraspinal and extra spinal effects of spondylolisthesis. They help in identifying pars defect, disc degeneration, disc herniation and also aid in staging the lesion.

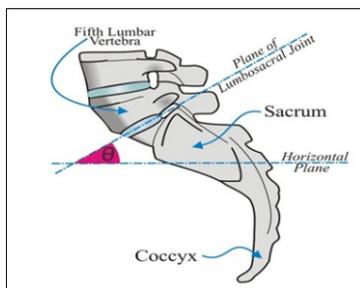
- Slip angle

With progressive spondylolisthesis, the body L5 vertebra slips over the first sacral vertebra. The slip angle is the angle formed between a line drawn parallel to the inferior end-plate of L5 and a line perpendicular to line drawn along the posterior aspect of the first sacral vertebra.



**Lumbosacral angle**

It is also known as the sacral base angle or Ferguson angle. It is the angle formed between the horizontal line and a line drawn along the sacral base. Normal angle ranges from 26 to 57 degrees. Any increase in this angle is suggestive of instability.

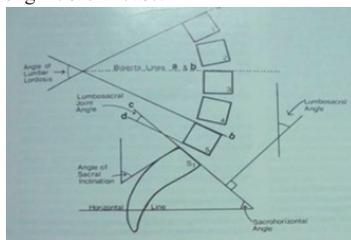


**Angle of lumbar lordosis**

It is the angle formed between the L1 and L5 vertebra.

**Lumbosacral joint angle**

It is formed by a line drawn parallel to the inferior endplate of L5 and another line along the sacral base.



- Oswestry Disability Index (ODI)

Numerous scoring system are being evaluated for the functional evaluation of low back pain such as Low Back Pain Score, Oswestry scoring Index, Visual Analog Scale, SF-16, Kirkaldy Willis Criteria. We commonly use the Oswestry scoring Index in our study as it is easy to use in our study especially in our community This ODI questionnaire was administered to evaluate the functional disability and the pain intensity.

**Scoring instructions**

For each section the total possible score is 5.

If the first statement is marked the section score = 0; if the last statement is marked, it = 5.

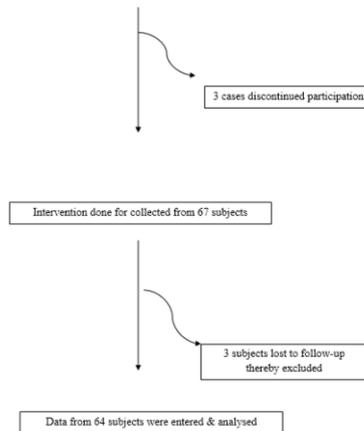
The score is expressed as percentage and thus calculated:  
Total score/Total possible score x 100%

**RESULTS**

**OBSERVATION AND RESULTS**

The present study was conducted on adults aged >30 years who were attending the Orthopaedics OPD, Meenakshi Medical College, Kanchipuram. The study attempted to assess functional and radiological outcome of lumbar spondylolisthesis treated with posterolateral fusion and with pedicular screw fixation.

The flows of participants were described in the flow chart below:



The results have been summarized under the following headings:-

- Background characteristics of the study population
- Description of injury
- Description of outcome
- Analysis of spondylolisthesis between sexes pre-operatively and post-operatively
- Analysis of final outcome following the surgery- posterolateral fusion and pedicular screw fixation

**1. DESCRIPTION OF INJURY**

**Table 1. Levels of slippage**

Levels	No	%	p-value
L4-L5	46	71.9	0.001
L5-S1	18	28.1	
Non-parametric chi square = 12.25 , p-value <0.05 indicates significance			

Maximum of the slippage was found to be present at L4-L5 level (71.9%) while only 28.1% was present at L5-S1 level. Non-parametric chi-square test was used to find the difference and it was found to be statistically significant(p<.05).

**Table 2. Distribution of final outcome**

Complications	No	%	p-value
Excellent	51	79.7	<0.001
Good	5	7.8	
Eventful	8	12.5	
Non-parametric chi square = 62.09 p-value <0.05 indicates significance			

The excellent outcome was found in the majority of the cases (79.7%) which was followed by eventful outcomes (12.5%) and good (7.8%). Non-parametric chi-square test was used and it revealed significant difference in the distribution of outcomes (p<.05).

**3. ANALYSIS OF SPONDYLOLISTHESIS BETWEEN SEXES**

**Table 3a. Gender wise pre-treatment assessment**

Sex	Slip Score		Slip Angle		ODI	
	Mean	SD	Mean	SD	Mean	SD
Male	24.25	6.61	22.69	8.46	59.50	9.78
Female	23.69	7.79	23.63	9.81	49.83	12.92
p-value = 0.820		p-value = 0.562		p-value = 0.003		
Independent t-test used p-value <0.05 indicates significance						

The pre-treatment assessment among males and females was shown in table4. The mean slip score and ODI were little higher in males than

females, The females were having higher slip angle than males (23.63 vs. 22.69). The difference in ODI between the sexes were statistically significant ( $p < .05$ ) as evaluated using Independent t-test

**4. FUNCTIONAL AND C.T GUIDED FUSION ANALYSIS OUTCOME OF LUMBAR SPONDYLOLISTHESIS TREATED WITH POSTEROLATERAL FUSION AND PEDICULAR SCREW FIXATION**

**Table 4. Pre-treatment & post-treatment comparison**

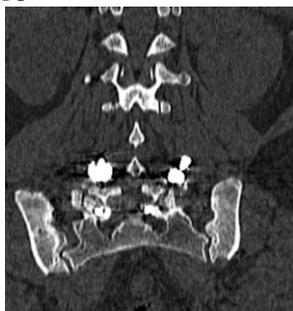
Variable	Slip Score		Slip Angle		ODI	
	Mean	SD	Mean	SD	Mean	SD
Pre-treatment	23.83	7.47	23.39	9.44	52.14	12.84
Post-treatment	15.56	7.97	15.28	8.51	16.00	8.85
	<b>p-value &lt;0.001</b>		<b>p-value &lt;0.001</b>		<b>p-value &lt;0.001</b>	
Paired t-test used p-value <0.05 indicates significance						

The table4 shows the pre-treatment and post-treatment comparison of subjects. The improvement in slip score, slip angle and ODI was significantly good in the post-treatment group as compared to the pre-treatment group ( $p < .05$ ). Paired-t-test was used to find the difference

**PRE-OP MRI**



**POST OPERATIVE CT IMAGE SHOWING PEDICLE SCREWS IN SITU**



**DISCUSSION**

In this study, the overall outcome following pedicle screw fixation with decompression and posterolateral fusion in patients with spondylolisthesis was successful with very significant reduction in the outcome variables like slip score, slip angle and ODI. The strengths

and limitations were also discussed.

With better understanding of the natural history and biomechanics, the treatment options have evolved over the time. Most patient respond well to conservative treatment and only a small percentage of individuals require surgery. Surgical treatment has been shown to produce good results once patients fail a 6-week trial of standardized nonsurgical treatment that includes physical therapy, medications, and spinal injections<sup>49</sup>

The main aim of surgery is to provide stable fusion across the unstable segment and to relieve pain and neurological deficit. Restoration of the segmental stability by adequate neural decompression, fusion, and stabilization helps to improve clinical symptoms and achieve normal spinal anatomy.

**OUTCOME**

The results from our study showed that, the chances of getting excellent results following posterolateral fusion and pedicle screw fixation with decompression will be seen in four fifth the observations. The findings from this study are superior to that found from Kho VKS et al, where they got only good results in 94.5% of their patients treated with posterior decompression laminectomy with foraminotomy and PLF using laminectomy bone chips as bone graft, with reduction of the slipped vertebra with transpedicle screws. In negation to these results Ekman P et al., proclaimed in his study that no significant improvement of outcome were observed in surgical group compared to conservative group in their long term follow-up as there was significant difference found in the short term follow-up.

**SUMMARY**

- The study subjects were adults with age >30 years and the mean age of the total study population was 50.45 ± 9.53 years.
- The study population is unequally distributed according to the gender with male to female ratio being 1:3
- L4-L5 level of slippage was found in the majority (71.9%) against 21.1% of cases having L5-S1 levels.
- Post-operatively, most of the cases had no complications (87.5%) and implant failure was seen in only 3.1% of subjects.
- The final outcome was excellent in 79.7% of cases while 12.5% had an eventful outcome for whom re-surgery required.
- Pre-operatively the severity of the disease condition as assessed by slip score and ODI showed higher values in males while slip angle in females had wide variation abnormally.
- Post-operatively the improvement in outcomes like slip score and slip angle was better with regard to female subjects and this improvement varied significantly among them against males.
- As a whole, following the postero-lateral fusion with pedicle screw fixation, the significant advancement of all the outcomes considered in our study were well appreciated.
- On comparison of the outcomes following surgery among the genders, the progress was well noticed in female subjects as they showed significant difference in all entities against the male group which showed a significant difference in having improved their ODI.

**CONCLUSION**

For individuals who do not respond to conservative management, fusion in situ remains the gold standard procedure and is known to produce long lasting good results. Of the various techniques available, the Posterolateral Fusion (PLF) with pedicular screw fixation offers better fusion rates with which the aforementioned surgical procedure started gaining popularity.

Patients included in the study showed good clinical response and significant pain reduction with no significant complication. Postoperatively, all patients achieved a pain free status to carry on with a comfortable functional daily living.

In conclusion, lumbar posterolateral fusion with pedicular screw fixation is an effective treatment option for spondylolisthesis with high fusion rates and minimal postoperative morbidity. However, the long-term effects of the procedure cannot be assessed within the study period and needs further investigation. Further studies has to be carried over in acquaintance of incidence of long term after effects and factors ascertaining the comfort zone of the subjects with which we can able to form a concrete platform to start with surgery and even new techniques added to it.

**References:**

1. Terry S Canale JHB. Campbell's Operative Orthopaedics, Scoliosis and Kyphosis. 41st ed. 2013. 1839-46 p.
2. Brantigan JW, Steffee AD GJ. A carbon fiber implant to aid interbody lumbar fusion. Mechanical testing. *Spine (Phila Pa 1976)*. 1991;16(6):S277-82.
3. Ali Araghi, DO and Peter F. Ullrich J. Posterolateral vs. Interbody Fusion: The Two Main Approaches to Spinal Fusion [Internet]. spinehealth.com. 2006. Available from: <http://www.spine-health.com/treatment/spinal-fusion/posterolateral-vs-interbody-fusion-two-main-approaches-spinal-fusion>
4. Fredrickson BE, Baker D, McHolick WJ, Yuan HA LJ. The natural history of spondylolysis and spondylolisthesis. *J Bone Jt Surg Am*. 1984;66:699-707.
5. Belfi LM1, Ortiz AO KD. Computed tomography evaluation of spondylolysis and spondylolisthesis in asymptomatic patients. *Spine (Phila Pa 1976)*. 2006;31(24):E907-10.
6. Jacobsen S1, Sonne-Holm S, Røvsing H, Monrad H GP. Degenerative lumbar spondylolisthesis: an epidemiological perspective: the Copenhagen Osteoarthritis Study. *Spine (Phila Pa 1976)*. 2007;32(1):120-5.
7. Denard PJ1, Holton KF, Miller J, Fink HA, Kado DM, Yoo JU ML. Lumbar spondylolisthesis among elderly men: prevalence, correlates, and progression. *Spine (Phila Pa 1976)*. 2010;35(10):1072-8.
8. Shastrakar, Rupali, Kasote A, Sawant V. Radiographic study of prevalence of spondylolisthesis and transitional lumbosacral segment in chronic low back pain subjects. *J Harmon Res Med Heal Sci*. 2015;2(1):12-7.
9. He LC1, Wang YX, Gong JS, Griffith JF, Zeng XJ, Kwok AW, Leung JC, Kwok T, Ahuja AT LP. Prevalence and risk factors of lumbar spondylolisthesis in elderly Chinese men and women. *eUR rADIOL*. 2014;24(2):441-8.
10. RB C. The treatment of ruptured lumbar intervertebral discs by vertebral body fusion: I: Indications, operative technique, after care. *J Neurosurg*. 1953;10:154-68.
11. RB C. Lesions of the intervertebral disks and their treatment by interbody fusion methods: the painful disk. *Clin Orthop*. 1963;27:51-77.
12. RB C. Spondylolisthesis: treatment by laminectomy and posterior interbody fusion. *Clin Orthop*. 1981;154:74-82.
13. RB C. Posterior lumbar interbody fusion updated. *Clin Orthop*. 1985;193:16-9.
14. PM 13. Lin. Posterior lumbar interbody fusion (PLIF): past, present, and future. *Clin Neurosurg*. 2000;47:470-82.
15. RJ H. Comparison of interbody fusion approaches for disabling low back pain. *Spine (Phila Pa 1976)*. 1997;22:660-5.