Original Research Paper ORTHOPAEDICS

A PROSPECTIVE STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF LUMBAR SPONDYLOLISTHESIS TREATED WITH POSTEROLATERAL FUSION AND PEDICULAR SCREW FIXATION

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KEYWORDS :

INTRODUCTION

The term Spondylolisthesis was first used by Kilian in 1854 and is derived from the Greek words spondylos and olisthenein meaning "vertebra" and "to slip" respectively

STUDY SETTINGS:

The present study was undertaken in the Department of Orthopedics at Melmaruvathur Adhiparasakthi Institute of Medical College Science and Research Institute,GST road,Melmaruvathur, Tamilnadu, India

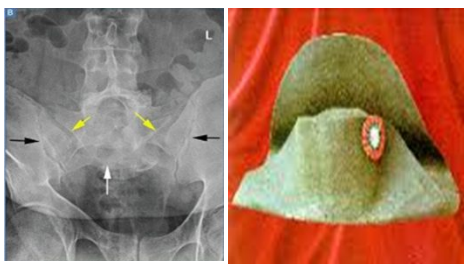
CLINICAL PRESENTATION

Low backache is the most common presenting complaint of spondylolisthesis. The pain is believed to be caused by mechanical instability. Ligamentous strain, disc degeneration, facet arthritis and pars fracture are also believed to contribute to the pain. With nerve root compression, patients present with radiculopathy or neurogenic claudication. .

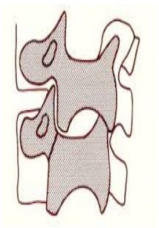
Patient eventually starts walking with an flexed hip and knee gait. This is known as the Phalen Dickson sign.

RADIOGRAPHIC FINDINGS:

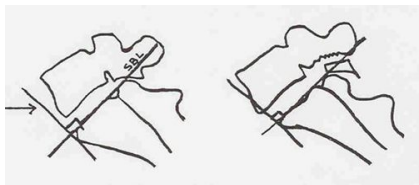
The "inverted Napoleon hat" sign is seen on the anteroposterior radio-graphs. It is seen with marked anterolisthesis of the L5 on S1 due superimposition of images. The brim of the hat is formed by the downward rotation of the transverse processes and the L5 body forms the dome.



In the oblique view, the posterior elements resemble the appearance of a "Scottish terrier dog" with the pars representing the neck of the dog. With a defect in the pars, the X-ray gives an appearance of beheading of the dog.



Ullman's sign is helpful in identifying doubtful cases of spondylolisthesis, A line is drawn along the superior articular surface of the sacrum and another perpendicular line is drawn passing through the anterior surface of the sacrum. Normally this line is at or anterior to the anteroinferior border of the L5. In spondylolisthesis, the latter is intersected by the perpendicular, due to the forward slipping.

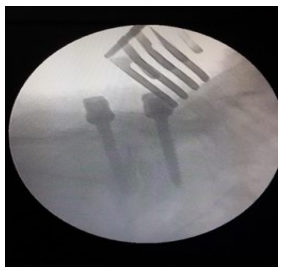


SURGICAL PROCEDURE

I. EXPOSURE OF THE DISC SPACE:
II. PEDICLE SCREW PLACEMENT:

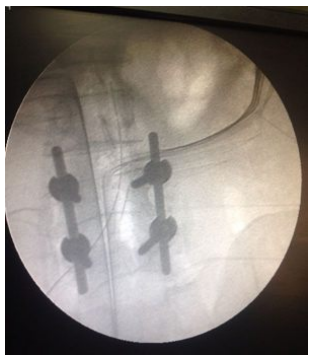
- **INTRA OPERATIVE FLUROSCOPIC IMAGE**
- **INTRODUCTION OF DRILL BIT INTO THE PEDICLE**

- **PLACEMENT OF PEDICLE SCREWS ON LATERAL VIEW**



- **PLACEMENT OF CONNECTING RODS TO THE PEDICLE SCREWS ON LATERAL VIEW**

- **PLACEMENT OF CONNECTING RODS TO THE PEDICLE SCREWS ON ANTEROPOSTERIOR VIEW**



- **OBSERVATION AND RESULTS**

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

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).

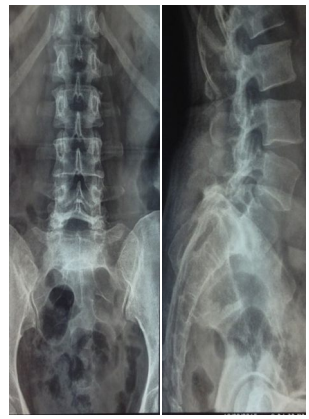
DESCRIPTION OF OUTCOME
ANALYSIS OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF LUMBAR SPONDYLOLISTHESIS TREATED WITH POSTEROLATERAL FUSION AND PEDICULAR SCREW FIXATION

Table 2. 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
	p-value <0.001		p-value <0.001		p-value <0.001	
Paired t-test used p-value <0.05 indicates significance						

The table2 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.

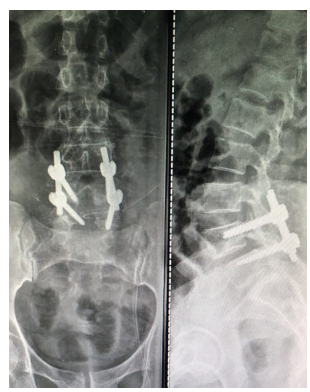
CASE 1: PRE-OP X RAY



POST OP X RAY

CASE 2.PRE-OP X RAY

POST-OP X RAY



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.

OUTCOME

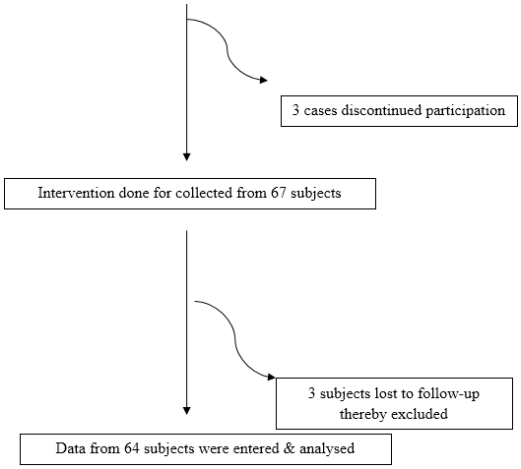
The results from our study showed that, the chances of getting excellent results following posterolateral fusion and pedicle screw fixation with decompression will be seen in four fifth the observations. The findings from this study are superior to that found from Kho VKS et al, where they got only good 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.

- **CONCLUSION**
- In conclusion, lumbar posterolateral fusion with pedicular screw fixation is an effective treatment option for spondy lolisthesis 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 acquantaince 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.

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

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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

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	p-value <0.001		**p-value <0.001**		**p-value <0.001**	
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

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 injections49

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 acquantaince 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. A M. Transforaminal lumbar interbody fusion. Orthop Clin North Am. 2002;33:359–66.
2. Lowe TG TA. Unilateral transforaminal posterior lumbar interbody fusion. Clin Orthop Relat Res. 2002;394:64–72.
3. Gokaslan ZL, Samudrala S, Deletis V et al. Intraoperative monitoring of spinal cord function using motor evoked potentials via transcutaneous epidural electrode during anterior cervical spinal surgery. J Spinal Disord. 1997;10:299–303.
4. Thomsen K1, Christensen FB, Eiskjaer SP, Hansen ES, Fruensgaard S BC. The effect of pedicle screw instrumentation on functional outcome and fusion rates in posterolateral lumbar spinal fusion: a prospective, randomized clinical study. Spine (Phila Pa 1976). 1997;20(24):2813–22.
5. Christensen FB1, Thomsen K, Eiskjaer SP, Hansen ES, Fruensgaard S, Gelinick J BC. The effect of pedicle screw instrumentation on posterolateral spinal fusion. A prospective, randomized study with a two-year follow-up. Ugeskr Laege. 1999;161(13):1920–5.
6. FB C. Lumbar spinal fusion. Outcome in relation to surgical methods, choice of implant and postoperative rehabilitation. Acta Orthop Scand. 2004;75(313):2–43.
7. Videbaek TS1, Christensen FB, Soegaard R, Hansen ES, Høy K, Helmig P, Niedermann B, Eiskjoer SP BC. Circumferential fusion improves outcome in comparison with instrumented posterolateral fusion: long-term results of a randomized clinical trial. Spine (Phila Pa 1976). 2006;31(25):2875–80.

8. Hiroyuki Hayashi, Hideki Murakami, Satoru Demura, Satoshi Kato, Norio Kawahara and HT. Outcome of posterior lumbar interbody fusion for L4-L5 degenerative spondylolisthesis. Indian J Orthop. 2015;49(3):284–8.
9. Christensen FB, Thomsen K, Eiskjaer SP, Gelinick J BC. Functional outcome after posterolateral spinal fusion using pedicle screws: comparison between primary and salvage procedure. Eur Spine J. 1998;7(4):321–7.
10. Dennis J. Rivet, , David Jeck, ., James Brennan, , Adrian Epstein B and CL. Clinical outcomes and complications associated with pedicle screw fixation—augmented lumbar interbody fusion. J Neurosurg Spine; 2005;1:67–72.
11. Terry S Canale JHB. Campbell's Operative Orthopaedics, Scoliosis and Kyphosis. 41st ed. 2013. 1839-46 p.
12. 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.
13. 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, Rovsing 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.
16. Boyd DM, Ellison NB. Social network sites: Definition, history, and scholarship. J Comput Mediat Comm. 2008; 13:210–230.
17. Number of internet users worldwide from 2005 to 2016, in millions. Available at http://www.statista.com/statistics/273018/number-of-internet-users-worldwide. Accessed March 2016
18. Facebook, Statistics, 2014. http://newsroom.fb.com/company-info/
19. Shimaa M.Saied. Internet and facebook addiction among Egyptian and Malaysian medical students: a comparative study, Tanta University, Egypt. International journal of community medicine and mental health 2016;3: 1288-1297
20. Elphinston, R. a, & Noller, P. (2011). Time to face it! Facebook intrusion and the implications for romantic jealousy and relationship satisfaction. Cyberpsychology, Behavior and Social Networking, 14(11), 631e635. http://dx.doi.org/ 10.1089/ cyber. 2010.0318
21. Andreassen CS, Torsheim T, Brunborg GS, Pallesen S. Development of a Facebook Addiction Scale. Psychol Rep 2012;110:501-17.
22. Ken Masters. Social networking addiction among health sciences students in oman.Sultan Qaboos University Med J 2015;15:357-363
23. Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook "friends:" Social capital and college students use of online social network sites. Journal of Computer-Mediated Communication, 12, 1143-1168.
24. M. Łaguna, K. Lachowicz-Tabaczek, I. Dzwonkowska, Skala samooceny SES Morrisa Rosenberga - polska adaptacja metody, Psychologia Społeczna, 02 (2007) 164-176.
25. NR Ramesh Masthi. Facebook addiction among health university students in Bengaluru. International journal health and allied sciences 2015;4:18-22
26. Mok JY, Choi SW, Kim DJ, Choi JS, Lee J, Ahn H, et al. Latent class analysis on internet and smartphone addiction in college students. Neuropsychiatr Dis Treat 2014;10:817-28.
27. Lin JY, Le AN, Cheng SK. Social media usage and work values: The Example of Facebook in Taiwan. Soc Behav Pers 2012;40:195-200.
28. Sami Abdo Radman Al-Dubai. Adverse health effects and unhealthy behaviours among medical students using facebook. The scientific world journal 2013; Article ID 465161 5 pages.
29. Agata Blachnio. Association between facebook addiction, self-esteem and life satisfaction:A cross-sectional study. Computers in human behavior 2016;55:701-705