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A RETROSPECTIVE STUDY ON THE OUTCOMES OF PEDICLE SCREW FIXATION VERSUS POSTERIOR LUMBAR INTERBODY FUSION WITH FIXATION IN DEGENERATIVE LUMBAR SPONDYLOLISTHESIS.

Neurosurgery

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ABSTRACT

Most common cause of low back pain and lower extremity pain is degenerative spondylolisthesis which is more common at level of L4, L5, more common in females, which can be diagnosed by basic dynamic flexion and extension lumbosacral X-Rays and it is graded 0 – 5 by meyerding. Initially managed conservatively if symptoms persist surgery required in the form of screw fixation. In our study pedicle screw fixation and posterior lumbar interbody fusion with fixation was analysed and pre and post operative visual analogue score and Oswestry disability scores were compared using the data from the past two and half years in the department of neurosurgery, Kurnool medical college, Kurnool. Patients 40 to 65 years with degenerative spondylolisthesis were included in the study, patients with trauma, infection, below 40 years, unstable fractures were excluded. 50 cases were enrolled divided into two groups, pedicle screw fixation (PLF), posterior lumbar interbody fusion with fixation (PLIF) was done and results were analysed and concluded L4, L5 is most common level involved, significant improvement in pain and functional status was observed in PLIF, hardware malfunction were less in PLIF group. literature review also suggests PLIF has advantage as in our study.

KEYWORDS

Lumbar spondylolisthesis, posterolateral fusion (PLF), posterior lumbar inter body fusion (PLIF), visual analogue scale (VAS)

INTRODUCTION

Lumbar spondylolisthesis is a relatively common condition that is recognized as a potential cause of low back and lower extremity pain. Wiltse[1] and Newman[2] originally classified spondylolisthesis into five groups that are dysplastic, isthmic, traumatic, pathologic, and degenerative causes. Surgical fusion of lumbar spondylolisthesis is an important method to stabilize spine, and is used to reduce pain and decrease disability in patients with chronic low back Pain[3]. Procedures that have been widely used in the treatment of spondylolisthesis include Posterolateral Fusion (PLF), Posterior Lumbar Interbody Fusion (PLIF), Transforaminal lumbar interbody fusion (TLIF), Anterior Lumbar Interbody Fusion (ALIF), and minimally invasive procedures[4-5]. PLF is often combined simultaneously with PLIF through solo posterior approach, aiming to further increase fusion rate and clinical satisfaction. However, it is uncertain whether the more complicate procedure when combined produces better clinical outcomes. The scientific evidence in favour of PLIF plus PLF remains lack. Controversy exists among surgeons when concerning the optimum fusion method and the effect of PLF in circumferential fusion on spondylolisthesis. The aim of this study is to evaluate the outcomes of pedicle screw fixation versus posterior lumbar interbody fusion with fixation in instrumented lumbar spinal surgeries.

Review Of Literature

Xiao-Yang Liu, MD et all 2014 [53] conducted a meta-analysis of 17 comparative studies in medline, embase and the Cochrane

Collaboration Library from January1950 through May 2013. Comparative studies were performed according to eligibility criteria. Weighted mean differences and risk differences were calculated for common outcomes. They concluded PLIF plus PLF did not show more superiority than PLF alone. PLIF alone improved clinical satisfaction and decreased complication rate compared with PLF. PLIF may be better than the other 2 fusion methods in the treatment of lumbar spondylolisthesis.

Mohamad Bydon, MD et al 2014[54] compare the cost-effectiveness of posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (/TLIF) versus non interbody fusion and posterolateral fusion (PLF) in patients with lumbar spondylolisthesis based on retrospective data from a single institutional series. Of 137 first-time lumbar fusions for spondylolisthesis, 83 patients underwent PLF and 54 underwent PLIF/TLIF. The average time to reoperation was 3.5 years. The mean QAL Yover 3.5 years was 2.81 in the PLF cohort versus 2.66 in the PLIF/TLIF cohort (p5.110) they concluded that after both the initial operation and first revision operation, the cost effectiveness ratio favoured non interbody fusions.

RicardoShigueaki GalhegoUmeta, Maria Fernanda Silber Caffaro1, Robert Meves1, Osmar Avanzi [55] 2015 conducted a retrospective, cross-sectional evaluation. Patients were selected who met the inclusion criteria of complete clinical and radiographic follow up for a minimum of six months, and the patients were discriminated by sex, average age at surgery, and age range and extremes. A total of 36 patients diagnosed with lumbar spondylosis and indicated for surgical treatment underwent decompression and lumbar arthrodesis using the TLIF (transforaminal interbody fusion) technique via the open or minimally invasive approach, depending on availability at the time of the procedure, in the Spine Surgery Group of our service during the period from September 2012 to January 2014. The patients were stratified based on the lumbar fusion surgical technique to which they had been submitted: Group 1 – interbody (cage) arthrodesis with 12 patients, 2 male and 10 female, with an average age of 43.67 years (ranging from 31 to 55 years of age); Group 2-posterolateral arthrodesis with 18 patients, 7 males and 11 females with an average age of 57.44 (ranging from 44 to 81 years of age). Both groups received local autologous bone grafts associated with iliac fragments where necessary. The patients were reevaluated cross-sectionally for quality of life, intensity of pain, and personal satisfaction using questionnaires provided by the author, the Oswestry Disability Index

Score (ODI), the Visual Analog Scale for Pain (VAS Pain), and the Short Form – 36 (SF-36). They concluded there is no clinical or radiographical differences between patients who underwent interbody arthrodesis and those who underwent posterolateral arthrodesis. Both methods resulted in functional and pain-related improvements.

Babak Alijani, Mohamahreza Emamhadi et al 2015 [56] conducted a prospective observational study of 102 surgical candidates with low grade degenerative and isthmic spondylolisthesis enrolled from 2012 to 2014, and randomly assigned into two groups: PLF and PLIF.

Evaluation of disability had been done by a questionnaire using Oswestry Disability Index (ODI). The questionnaire was completed by

all patients before the surgery, the day after surgery, after 6 months and after 1-year. They concluded that both surgical fusion techniques (PLF and PLIF) were efficient to lessen the disability of patients with spondylolisthesis, and none of the fusion techniques were related to a better outcome in terms of disability.

Ryan C. Campbell et al 2017 compared the functional and operative outcomes after fusion against interbody fusion in the treatment of degenarative Spondylolisthesis. It was a systematic review of the literature comparing posterolateral fusion (PLF) and posterior lumbar interbody fusion (PLIF) outcomes in the treatment of degenarative Spondylolisthesis and was performed using the Preferred Reporting Items for Systematic Reviews and metaanalysis (PRISMA) guidelines. Electronic searches of 6 databases yielded 386 articles from database inception to July 2016, which were screening against established criteria for inclusion into this study. A total of 6 studies, satisfied criteria and reported outcomes for 721 patients. Fusion alone was performed in 458 (63.5%) patients and interbody fusion was performed in 263 (36.5%) patients. Functional outcomes Oswestry Disability Index (P ¼ .29) and visual analog scale (P ¼ .13) were not statistically different between the 2 approaches. Furthermore, there was no significant inferiority between fusion alone and with interbody in terms of the operative outcomes of blood loss (P ¼ .38), reoperation rate (P ¼ .66), hospital stay (P ¼ .96), complication rate (P ¼ .78), or fusion rate (P ¼ .15). They concluded that there was no statistically significant difference in functional and operative outcomes following fusion alone versus with interbody.

Yijian Zhang et al 2018 [57] compared the spino-pelvic sagittal balance and clinical outcomes of patients treated with posterolateral fusion (PLF) and posterior lumbar interbody fusion (PLIF) for degenerative spondylolisthesis.

They studied 72 patients (28 patients treated with PLF and 44 patients treated with PLIF). The spino-pelvic sagittal balance, Numerical Rating Scale (NRS), and Oswestry Disability Index (ODI) of the PLF and PLIF groups were compared. The incidence of postoperative chronic low back pain (improvement of NRS less than 50%) in the two groups was also recorded. Significant restoration of spino-pelvic sagittal balance was observed in the PLIF group after surgery. Both groups achieved significant improvements in NRS and ODI postoperatively. Significant differences in postoperative lumbar lordosis and pelvic tilt were found between the PLF and PLIF groups. Significant difference in the incidence of postoperative chronic low back pain was also detected between the two groups. They Concluded that PLF and PLIF can improve the clinical outcomes of patients with degenerative spondylolisthesis. PLIF can achieve better restoration of spino-pelvic sagittal balance parameters and less incidence of postoperative chronic low back pain than PLF.

MATERIAL & METHODS

Study Design:

This is a retrospective study done from data collected past two and half years in Department of Neurosurgery, Government General Hospital - Kurnool.

Inclusion Criteria:

1.Patients between age group 40 and 65 years. 2. Patients suffering with degenerative spondylolisthesis.

Exclusion Criteria:

1.Patients with age group below 40 and above 65 years. 2. Trauma 3. Unstable Fractures 4. Tumours 5. Infection /Discitis

RESULTS

The present study "A retrospective study on the outcomes of pedicle screw fixation versus posterior lumbar interbody fusion with fixation in degenerative lumbar spondylolisthesis" was conducted in the Department of Neurosurgery, Kurnool Medical College, Kurnool with the data of past two and half years.

Fifty cases with spondylolisthesis were taken and were randomly enrolled into two groups. 25 patients who underwent posterolateral fusion (PLF) were kept in Group1 and rest of the 25 patients, those who underwent posterior lumbar with interbody fusion with fixation (PLIF+PLF), were kept in Group2.

Table 1: Distribution Of Cases According To Sex.

Gender	Group-1	Group-2
Males	8	7
Females	17	18

Table 1 depicts there were 8 male and 17 female group1 (PLF) and 7 male and 18 female in group2 (PLIF+PLF). The chi-square statistic is 0.0168. The p-value is .896876. Not significant at p < .05.

Table 2: Age Distribution

Age in Years	Group-1	Group-2
41-50	12	13
51-60	13	11
61-65	0	1

Table 2 depicts the comparison in distribution of cases according to age in both groups. There are 13 cases in group1(PLF) and 13 cases in group2 (PLIF+PLF) less than 50 years of age, 12 cases in group1 and 12 cases in group2 more than 50 years of age. Mean age of cases in group1 is 50.96 years and in group2 is 51.6 years. The t-value is -0.5547. The p-value is .304327. The result is not significant at p < .05.

Table3: Distribution Of Cases According To Level Of Involvement.

Level of Listhesis	Group-1	Group-2
L4-L5	19	20
L5-S1	6	5

Table 3 depicts level of listhesis involved, in group1 (PLF) 19 cases were having L4/L5 listhesis and 6 cases were having L5/S1 listhesis while in group2 (PLIF+PLF) 20 cases were having L4/L5 listhesis and 5 cases were having L5/S1listhesis. The chi-square statistic is 0. The p-value is 1. Not significant at p < .05

Table 4: Distribution of cases according to pre operative VAS score.

V.A.S. Score	Group-1	Group-2
5	3	3
6	6	7
7	12	10
8	4	5

Table 4 depicts the distribution of vas score in group1 and group2, in group 1 3 patients were presented with preoperative V.A.S. score 5, 7 patients were having preoperative V.A.S. score 6, 12 patients were having V.A.S. score 7 and 3 patients were having V.A.S. score 8. In group2, 3 patients were presented with preoperative V.A.S. score 5, 7 patients were having preoperative V.A.S. score 6, 10 patients were having V.A.S. score 7 and 5 patients were having V.A.S. score 8. Mean preoperative V.A.S. score in group1 was 6.60 and in group2 was 6.68. The t-value is - 0.29277. The p-value is .38978. The result is not significant at p < .05.

Table 5: Distribution of cases according to post operative VAS score.

V.A.S. Score	Group-1	Group-2
1	0	4
2	7	11
3	10	6
4	8	4

Table 5 depicts the distribution of postoperative V.A.S. score in group1 and group2, in group1, 7 patients were presented with post operative V.A.S. score 2, 10 patients were having post operative V.A.S. score 3, 8 patients were having V.A.S. score 4. In group2, 4 patients were presented with post operative V.A.S. score 1, 11 patients were having post operative V.A.S. score 2, 6 patients were having post operative V.A.S. score 3 and 4 patients were having post operative V.A.S. score 4. Mean post operative V.A.S. score in group1 was 3.0 and in group2 was 2.4. The t-value is -0.26414. The p-value is .400257. The result is not significant at p < .05.

Table 6: Distribution of cases according to preoperative ODI score.

O.D.I. Score	Group-1	Group-2
40-50	12	11
51-60	10	10
>60	3	4

Table -6 depicts the distribution of ODI score in group1 and group2. In

group 1, 12 patients were presented with preoperative ODI score between 40-50, 10 patients were having preoperative ODI score between 50-60, 3 patients were having ODI score more than 60. In group2, 11 patients were presented with preoperative ODI score between 40-50, 10 patients were having preoperative ODI score between 50-60, 4 patients were having ODI score more than 60. Mean preoperative ODI score in group1 was 52.0 and in group2 was 52.6. The t-value is -0.26968. The p-value is .400374. The result is not significant at p < .05

Table 7: Distribution Of Cases According To Post Operative ODI Score.

O.D.I. Score	Group-1	Group-2
0-10	4	5
11 to 20	18	19
>20	3	1

Table -7 depicts the distribution of postoperative ODI score in group1 and group2. In group1, 4 patients were presented with postoperative ODI score between 0-10, 19 patients were having postoperative ODI score between 10-20, 2 patient was having ODI score more than 20. In group2, 5 patients were presented with postoperative ODI score between 0-10, 19 patients were having postoperative ODI score between 10-20, 1 patient was having ODI score more than 20. Mean postoperative ODI score in group1 was 17.6 and in group2 was 15.1. The t-value is -0.12649. The p-value is .452723. The result is not significant at p < .05.

Table 8: Distribution Of Cases According To Cases According To Preoperative Degree Of Listhesis Grading.

Grade	Group-1	Group-2
I (0-25%)	15	11
II (26-50%)	10	12
III (51-75%)	0	2

Table -8 depicts the distribution of cases according to preoperative degree of listhesis or grading in group1 and group2. In group 1, 15 patients were presented with preoperative degree of listhesis between 0-25degree, 10 patients were having with preoperative degree of listhesis between 26-50degree. In group 2, 11 patients were presented with preoperative degree of listhesis between 0-25degree, 12 patients were having with preoperative degree of listhesis between 26=50degree, 2 patients were having preoperative degree of listhesis between 5175degree. Mean preoperative degree of listhesis in group1 was 23degrees and in group2 was 27.84degrees. The t-value is -0.26261. The p-value is .40291. The result is not significant at p < .05.

Table 9: Distribution Of Cases According To Post Operative Degree Of Listhesis Grading.

Grade	Group-1	Group-2
0 - 10%	18	17
11 - 20%	6	7
>20%	1	1

Table-9 depicts the distribution of cases according to post op degree of listhesis or grading in group1 and group2. In group 1, 18 patients achieved post op degree of listhesis between 0-10degree, 6 patients achieved post op degree of listhesis between 11-20degree and 1 patient achieved post op degree of listhesis more than 20degree. In group 2, 17 patients achieved post op degree of listhesis between 0-10degree, 7 patients achieved post op degree of listhesis between 11-20 degree and 1 patient achieved post op degree of listhesis more than 20 degree. Mean post op degree of listhesis in group1 was 7.48degrees and in group2 was 8.48degrees. The t-value is -0.16117. The p-value is .439888. The result is not significant at p < .05.

Table 10: Distribution Of Cases According To Pre Operative Intervertebral Disc Height.

Disc Height(mm)	Group-1	Group-2
4.0-6.0	0	5
6.1-8.0	13	10
8.1-10.0	12	10

Table-10 depicts the distribution of preoperative intervertebral disc height in mm in group1 and group2. In group 1, 13 patients were having preoperative intervertebral disc height between 6.1-8.0mm, 12 patients were having preop intervertebral disc height between 8.1-10mm. In group 2, 5 patients were having preoperative intervertebral disc height between 4.0-6.0mm, 10 patients were having preoperative intervertebral disc height between 6.1-8.0mm, 10 patients were having preoperative intervertebral disc height between 8.1-10mm. Mean preoperative intervertebral disc height in group1 was 8.1mm and in group2 was 7.7mm. The t-value is - 0.24434. The p-value is .409495. The result is not significant at p < .05.

Table 11: Distribution Of Cases According To Post Operative Intervertebral Disc Height.

Disc Height(mm)	Group-1	Group-2
8.0-9.5	18	2
9.6-11.0	7	14
>11.0	0	9

Table -11 depicts the distribution of post op intervertebral disc height in mm in group1 and group2. In group 1, 18 patients were having post op intervertebral disc height between 8.0-9.5mm, 7 patient were having post op intervertebral disc height between 9.6-11mm. In group 2, 2 patients were having post op intervertebral disc height between 8.1-9.5mm, 14 patients were having post op intervertebral disc height between 9.6-11mm, 9 patients were having preop intervertebral disc height of more than 11mm. Mean post op intervertebral disc height in group1 was 9.4mm and in group2 was 10.3mm. The t-value is -0.13131. The p-value is .450936. The result is not significant at p< .0.05

Table 12: Distribution Of Patients According To Complications.

Complications	Group-1	Group-2
Wound Infection	1	1
hardware malfunction	2	1
transient radiculopathy	3	2

Table-12 depicts wound infection in two patients one from group1(PLF) and another one from group2 (PLIF+PLF), hardware malfunction occurred in two patients of group1 and one patient of group2, and postoperative transient radiculopathy occurred in three patients of group1 (PLF) and two patients of group 2 (PLIF+PLF).

Follow Up X-ray At One Month Showing L4-L5 PLF Using Rods And Screws

Follow Up X-ray At Three Months Showing L4-L5 PLF+PLIF Using Rods Screws And Cage

Degenerative Spondylolisthesis occurs owing to prolonged segmental instability; however, the segmental instability undergoes auto stabilization over time, which reduces its mobility. Iguchi et al found that, in patients with back and radicular pain, there was a double peak in the age curve of patients with lumbar segmental instability: one from the second to third decades, and the other in the later fifth decade. In the early 40s, angular instability is more common, whereas the prevalence of translational instability peaks in the early 50s. Subsequently, the

prevalence of segmental instability tends to decrease. Surgical fusion of lumbar spondylolisthesis is an important method to stabilize spine, and is used to reduce pain and decrease disability. In the current study, the operative results with and without cage support were compared by VAS & ODI scores and analysed.

In this study, majority of the patient, 17 out of 25 in group1 and 18 out of 25 in group2 were female patients. Most of the cases, 12 out of 25 in group 1 and 12 out of 25 in group2 were more than fifty years of age. Mean age was 50.8 yrs in group 1 and 51.6 in group 2. In a study by **Yijian Zhang et al 2018** 57, Twenty-eight patients (6 males and 22 females) underwent PLF (mean age 66yrs), whereas 44 patients (14 males and 30 females) underwent PLIF (mean age 68yrs) that is majority were female comparable to our study. Out of fifty patients thirtynine patients were having L4/L5 spondylolisthesis and eleven patients were having L5/S1 spondylolisthesis. They were distributed as in group1 (PLF) 19 cases were having L4/L5 listhesis and 6 cases were having L5/S1 listhesis while in group2 (PLIF+PLF) 20 cases were having L4/L5 listhesis and 5 cases were having L5/S1listhesis. So, in this study, involvement of L4/L5 is more compared to L5/S1, similar to **Bydon et al[61].**

Mean preoperative V.A.S. score of Group1(PLF) was 6.6 and in Group2 was 6.68 (p value was 0.3897 ie. Not significant). Both groups were comparable to each other. . Mean postoperative V.A.S. score in group1 was 3.0 and in group2 was 2.4 (p value was 0.3897 i.e. Not significant). So in Group1 V.A.S. score significantly decreased from 6.6 to 3.0 and in Group2 from 6.68 to 2.4. In this study, potential improvement of clinical symptoms after PLIF+PLF are more compared to PLF. This result may attribute to the placement of the cage between the vertebral bodies in PLIF, which can increase the stability of segments, reduce the intradiscal pressure and lamina strain, maintaining the normal lumbar and pelvic sagittal balance parameters[60]. The study by **Elkman et al**.[58] reported that pain was significantly reduced to a similar extent for patients treated with PLF and PLIF after 2 years. In this study we compared functional status of Group1(PLF) and Group2(PLIF+PLF) before and after intervention and found mean preoperative ODI score in Group1 was 52.0 and in Group2 was 52.56 and was comparable (p value was 0.40037 ie. Not significant) and mean postoperative ODI score in Group1 was 17.6 and in Group2 was 15.12 (p value was 0.45272 ie. Not significant). So in Group1 ODI score significantly decreased from 52.0 to 17.6 and in Group2 from 52.56 to 15.12. So in this study improvement of functional status are comparable that is in agreement with **Cheng et al.**59 for degenerative spondylolisthesis, and **Ekman et al.**58 study. Preoperative degree of listhesis in Group1 and Group2 compared. Mean preoperative degree of listhesis in group1 was 23degree and in group2 was 27.84 degree (p value was 0.40291 i.e. Not significant) and mean postoperative degree of listhesis in group1 was 7.48degree and in group2 was 8.48 degree (p value was 0.43988 i.e. Not significant). So in Group1 degree of listhesis significantly decreased from 23 to 7.48 degree and in Group2 from 27.84 to 8.48 degree. So in this study reduction of degree of listhesis were significant, similar to the study done by **Kee-Yong Ha et al.**[62] Mean preop intervertebral disc height in group1 was 8.1mm and in group2 was 7.7mm (p value was 0.40949 i.e. Not significant) and mean post op intervertebral disc height in group1 was 9.4mm and in group2 was 10.3mm(p value was 0.45093 i.e. Not significant). So in Group1 disc height significantly increased from 8.1mm to 9.4mm and in Group2 from 7.7mm to 10.3mm. There was minimal increase (1.3mm) in the disc height in group1 and the disc height increased by 2.6mm in group2 comparable to the study done by **Kee-Yong Ha et al.**[62]

In present study superficial wound infection was noted in two case one from Group1(PLF) and another from Group2(PLIF+PLF). Wound infection dealt with proper dressing and appropriate antibiotics.

Implant failure or hardware malfunction occur in 3 patients of Group1 (PLF) as inny came out in one case which was readjusted at 3 months when patient came for follow-up, rod slippage in one case which was readjusted at six months when patient came for follow up and in one patient screw breakage at one year follow up, for which new screw were placed in place of broken screws.

CONCLUSION

Male to female ratio of incidence of symptomatic spondylolisthesis was 1:2.3 L4/L5 level is the most common level involved compared to L5/S1 level involvement in the symptomatic spondylolisthesis.

Postoperatively pain and functional status were improved in PLF and PLIF+PLF Group, but significant improvement was observed in PLIF+PLF Group.

Slip grade and percentage were significantly improved in PLF and PLIF+PLF Group and there was no difference in both groups.

Future Scope

In future more different types and minimal invasive technique and studies will help reduce the morbidity.

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