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**Original Research Article**

# Comparison of early clinico-radiological outcome of posterolateral fusion and transforaminal lumbar interbody fusion techniques

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## ABSTRACT

**Background**: The objective is to analyse clinico-radiological outcome with respect to functional disability, pain, fusion rate of patients treated with TLIF compared to instrumented PLF techniques for lumbar spinal stabilization.
**Methods:** Monocentric retrospective study with an average follow up of 36 months in patients who underwent surgery from January 2016 to December 2017. Out of 140 participants, 78 males and 62 females with mean age 52.22 (±11.97) years; 78 underwent PLF and 62 underwent TLIF. Assessment was done using VAS score and ODI score before surgery and post-surgery at 3, 6, and 18 weeks and thereafter at 18, 24 and 36 months. Radiologically sagittal and coronal angles were measured both preoperatively and postoperatively and evaluation of correction in sagittal and coronal angle was calculated.
**Results:** We observed highly significant reduction in the post-operative VAS score, ODI Score compared to pre-operative scores in both TLIF and PLF group but radiologically TLIF gives better correction in sagittal balance and rotational alignment compared to PLF.
**Conclusions:** We conclude that in the short term duration of our study, both the procedures done with proper technique in duly indicated patients shows satisfactory clinical outcome. However, radiologically TLIF patients had better outcome. We expect better outcome in long term with TLIF compared to PLF. In presence of insignificant blood loss, surgical duration and better $360^0$ fusion TLIF is preferred over PLF.

**Keywords:** Posterolateral fusion, Transforaminal lumbar Interbody fusion

## INTRODUCTION

With increase in life expectancy the degenerative spinal disorder have also increased like spinal stenosis, degenerative disc disease, and degenerative deformities.[1,2] Most of the patients are initially treated with conservative approach. Those who do not have relief with conservative approach or in presence of neurological deterioration, surgical option are considered in the form of spinal fusion along with decompression. Instability due to degenerative spine disease is treated surgically by achieving fusion either posterolateral or by interbody technique. Both methods are equally effective but some researchers believe TLIF provides better mechanical stability and maintains it. The objective of current study was to analyse clinico-radiological outcome with respect to functional disability, pain, fusion rate of patients treated with TLIF compared to instrumented PLF techniques for lumbar spinal stabilization.

## METHODS

### *Study type, design and location*

Current study was a retrospective cohort Monocenteric observational study. The study was conducted at the

department of orthopaedics, Seth Nandlal Dhoot Hospital, Aurangabad.

***Inclusion criteria***

Patients who have been operated for spinal instability, Spinal stenosis, degenerative disc disease, spondylolisthesis with neurological symptoms were included in the study.

***Exclusion criteria***

Patients who had severe osteoporosis, infection, or malignancy were excluded from the study.

Written consent of all the patients were taken from all the participants. Duration of the study was between January 2016 and December 2017. Patients were followed up retrospectively till Dec 2019 with an average follow up of 36 months. Total sample size was 140 patients out of which 78(n=78, 55.71%) were male and 62(n=62, 44.29%) were female.

***Statistical analysis***

Out of 140 patient 78 underwent PLF and 62 underwent TLIF (Table1-2).

**Table 1: Demographic information of study subjects.**

| Study variable | Posterolateral fusion | | Transforaminal lumbar interbody fusion | | Total | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| **Occupation of patient** | | | | | | |
| House wives | 21 | 26.92 | 17 | 27.42 | 38 | 27.14 |
| Farmers | 21 | 26.92 | 14 | 22.58 | 35 | 25.00 |
| Drivers | 15 | 19.23 | 12 | 19.35 | 27 | 19.29 |
| Manual labourer | 14 | 17.95 | 10 | 16.13 | 24 | 17.14 |
| Computer professional | 2 | 2.56 | 6 | 9.68 | 8 | 5.71 |
| Company workers | 3 | 3.85 | 2 | 3.23 | 5 | 3.57 |
| Mechanic | 2 | 2.56 | 1 | 1.61 | 3 | 2.14 |
| **Patient condition** | | | | | | |
| Spondylolysthesis | 20 | 25.64 | 22 | 35.48 | 42 | 30.00 |
| Spinal stenosis | 22 | 28.21 | 17 | 27.42 | 39 | 27.86 |
| Degenerative disc disease | 18 | 23.08 | 16 | 25.81 | 34 | 24.29 |
| Spinal instability | 18 | 23.08 | 7 | 11.29 | 25 | 17.86 |
| **Age of patient (years)** | | | | | | |
| <40 | 11 | 14.10 | 9 | 14.52 | 20 | 14.29 |
| 40-59 | 38 | 48.72 | 34 | 54.84 | 72 | 51.43 |
| ≥ 60 | 29 | 37.18 | 19 | 30.65 | 48 | 34.29 |
| Mean age (± SD) | 51.47 ±11.68 | | 52.82 ±12.23 | | 52.22±11.97 | |
| **Gender of patient** | | | | | | |
| Male | 47 | 60.26 | 31 | 50.00 | 78 | 55.71 |
| Female | 31 | 39.74 | 31 | 50.00 | 62 | 44.29 |
| Total | 78 | 55.71 | 62 | 44.29 | 140 | 100.00 |

The mean age of the patients in the TLIF group was 52.82 (±12.23), and the mean age of the patients in the PLF group was 51.47 (±11.68).

Out of 78 PLF patient 47 are male and 31 are female and out of 62 TLIF patients 31 are male and 31 are female. Clinical and radiological outcomes were serially evaluated upto 36 months retrospectively in each cohort.

***Surgical procedure***

After standard soft tissue dissection pedicle screws were inserted, decompression was done in the form of laminectomy, excision of hypertrophied ligamentum flavum and medial facetectomy if required for all the patients. In PLF group distraction was done and rods were placed and then decortication of transverse process and pars was done.

Locally harvested autograft was placed posterolaterally for fusion. In TLIF group distraction was done and rods were placed. Discectomy done and end plates curated, locally harvested autograft placed anteriorly and then bone graft impacted cage was inserted.

**Table 2: Pre-post comparison of study variables in PLF group.**

| Study variable | | Mean | N | SD | SEM | T stat | P value |
|---|---|---|---|---|---|---|---|
| **VAS** | Pre-operative | 6.048 | 62 | 1.487 | 0.189 | 25.425 | <0.001** |
| | Post-operative | 2.839 | 62 | 1.074 | 0.136 | | |
| **ODI** | Pre-operative | 54.774 | 62 | 9.855 | 1.252 | 38.900 | <0.001** |
| | Post-operative | 12.177 | 62 | 2.917 | 0.370 | | |
| **Coronal angle** | Pre-operative | 16.097 | 62 | 1.676 | 0.213 | 53.689 | <0.001** |
| | Post-operative | 4.677 | 62 | 0.937 | 0.119 | | |
| **Lumbar Lordosis angle** | Pre-operative | 20.790 | 62 | 1.794 | 0.228 | -39.914 | <0.001** |
| | Post-operative | 33.016 | 62 | 1.937 | 0.246 | | |

Operation procedure=posterolateral fusion (PLF); **Significance at 1% level of significance.

**Table 3: Pre-post comparison of study variables in TLIF group.**

| Study variable | | Mean | N | SD | SEM | T stat | P value |
|---|---|---|---|---|---|---|---|
| **VAS** | Pre-operative | 5.833 | 78 | 1.189 | 0.135 | 27.261 | <0.001** |
| | Post-operative | 2.872 | 78 | 0.998 | 0.113 | | |
| **ODI** | Pre-operative | 56.782 | 78 | 8.294 | 0.939 | 52.413 | <0.001** |
| | Post-operative | 13.218 | 78 | 3.238 | 0.367 | | |
| **Coronal angle** | Pre-operative | 13.205 | 78 | 1.976 | 0.224 | 37.352 | <0.001** |
| | Post-operative | 4.500 | 78 | 1.114 | 0.126 | | |
| **Lumbar Lordosis angle** | Pre-operative | 20.038 | 78 | 2.371 | 0.268 | -40.959 | <0.001** |
| | Post-operative | 30.038 | 78 | 2.230 | 0.252 | | |

Operation procedure=posterolateral fusion (PLF); **Significance at 1% level of significance.

***Assessment and outcome***

Patient's outcome was assessed on the basis of data which was taken from Medical record department of hospital; clinically patient's pain and well-being was assessed using VAS score and ODI score before surgery and post surgery at 3 weeks, 6 weeks and 18 weeks and thereafter at 18, 24 and 36 months. Radiologically lumbar sagittal and coronal angles were assessed both preoperatively and postoperatively on AP and lateral X ray views. Evaluation of correction in saggital and coronal angle were done by Cobbs angle. Radiologically the fusion was assessed by Lenke's method. The four grades according to Lenke's method were judged by anteroposterior radiograph which are as follows: grade A: bilateral definately solid stout fusion masses present; grade B: probably solid with a unilateral stout fusion mass and contralateral thin fusion mass; grade C: probably not solid with a thin unilateral fusion mass and grade D: definately not solid with thin fusion masses bilaterally with obvious pseudoarthrosis or bone graft dissolution bilaterally. Brand Tegan and Steffee method of grading interbody fusion which was modified to describe the Fraser definition of locked pseudoarthrosis (BSF scale) was used. In order to eliminate any possible errors regarding the X-ray interpretation, all X-rays were evaluated by the operating team and by another orthopaedic surgeons and result were analysed statistically.

## RESULTS

The following table shows comparison of pre-operative and post-operative VAS score, ODI score, coronal angle and lumbar lordosis angle in PLF group. VAS score; the mean pre-operative VAS score was 6.048 (±1.487) and mean post-operative VAS score was 2.839 (±1.074). The t-test analysis indicates a highly significant reduction in the post-operative VAS score ($p<0.001$). ODI score; the mean pre-operative ODI score was 54.774 (±9.855) and mean post-operative ODI score was 12.177 (±2.917). The t-test analysis indicates a highly significant reduction in the post-operative ODI score ($p<0.001$). Coronal angle; the mean pre-operative coronal angle was 16.097 (±1.676) and mean post-operative coronal angle was 4.677 (±0.937). The t-test analysis indicates a highly significant reduction in the post-operative mean coronal angle ($p<0.001$). Lumbar lordosis angle; the mean pre-operative Lumbar Lordosis angle was 20.790 (±1.794) and mean post-operative Lumbar Lordosis angle was 33.016 (±1.937). The t-test analysis indicates a highly significant increase in the post-operative mean Lumbar Lordosis angle ($p<0.001$).

**Table 4: Significance of mean difference between pre-op and post-op values of study variables.**

| Study variable | Operation procedure | | Mean | MD | SD | SEDM | P value |
|---|---|---|---|---|---|---|---|
| **VAS Score** | PLF | Pre-operative | 6.048 | 3.210 | 0.994 | 0.126 | 0.137, NS |
| | | Post-operative | 2.839 | | | | |
| | TLIF | Pre-operative | 5.833 | 2.962 | 0.959 | 0.109 | |
| | | Post-operative | 2.872 | | | | |
| **ODI Score** | PLF | Pre-operative | 54.774 | 42.597 | 8.622 | 1.095 | 0.475, NS |
| | | Post-operative | 12.177 | | | | |
| | TLIF | Pre-operative | 56.782 | 43.564 | 7.341 | 0.831 | |
| | | Post-operative | 13.218 | | | | |
| **Coronal Angle** | PLF | Pre-operative | 16.097 | 11.419 | 1.675 | 0.213 | <0.001 |
| | | Post-operative | 4.677 | | | | |
| | TLIF | Pre-operative | 13.205 | 8.705 | 2.058 | 0.233 | |
| | | Post-operative | 4.500 | | | | |
| **Lumbar Lordosis Angle** | PLF | Pre-operative | 20.790 | -12.226 | 2.412 | 0.306 | <0.001 |
| | | Post-operative | 33.016 | | | | |
| | TLIF | Pre-operative | 20.038 | -10.000 | 2.156 | 0.244 | |
| | | Post-operative | 30.038 | | | | |

The following table shows comparison of pre-op and post-op VAS score, ODI score, coronal angle and lumbar lordosis angle in TLIF group. VAS score: the mean pre-operative VAS score was 5.833 (±1.189) and mean post-operative VAS score was 2.872 (±0.998).

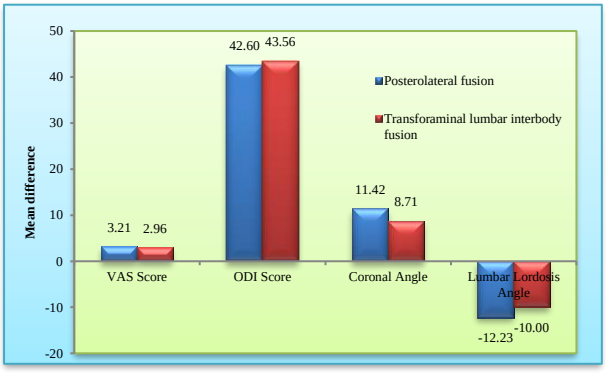



**Figure 1: Significance of mean difference between pre-op and post-op values of study variables.**

The t-test analysis indicates a highly significant reduction in the post-operative VAS score (p<0.001). ODI score: The mean pre-operative ODI score was 56.782 (±8.294) and mean post-operative ODI score was 13.218 (±3.238). The t-test analysis indicates a highly significant reduction in the post-operative ODI score (p<0.001). Coronal angle: The mean pre-operative coronal angle was 13.205 (±1.976) and mean post-operative coronal angle was 4.500 (±1.114). The t-test analysis indicates a highly significant reduction in the post-operative mean coronal angle (p<0.001). Lumbar Lordosis angle: The mean pre-operative Lumbar Lordosis angle was 20.038 (±2.371) and mean post-operative Lumbar Lordosis angle was 30.038 (±2.230). The t-test analysis indicates a highly significant increase in the post-operative mean Lumbar Lordosis angle (p<0.001).

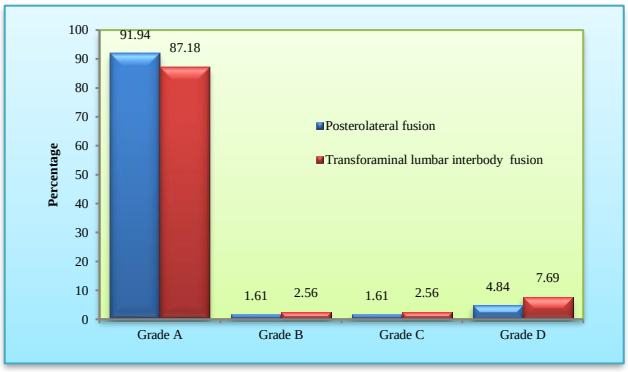



**Figure 2: Association between LENKES grading and operation procedure.**

The following table indicates significance of the mean difference between the pre-operative and post-operative mean VAS score, ODI score, coronal angle and lumbar Lordosis angle. VAS score: The mean difference between pre-operative and post-operative VAS score in PLF group was 3.210 (±0.994) and in TLIF group it was 2.962 (±0.959). The result of t-test indicates no significant difference in the mean difference in two groups (p=0.137). ODI score: The mean difference between pre-operative and post-operative ODI score in PLF group was 42.598 (±8.622) and in TLIF group it was 43.564 (±7.341).The result of t-test indicates no significant difference in the mean difference in two groups (p=0.475). Coronal angle: The mean difference between pre-operative and post-operative Coronal angle in PLF group was 11.419 (±1.675) and in TLIF group it was 8.705 (±2.058).The result of t-test indicates a highly significant difference in the mean difference in two

groups (p<0.001). Lumbar Lordosis angle: The mean difference between pre-operative and post-operative Lumbar Lordosis Angle in PLF group was -12.226 (±2.412) and in TLIF group it was -10.000 (±2.156).The result of t-test indicates a highly significant difference in the mean difference in two groups (p<0.001).

**Table 5: Association between LENKES grading and operation procedure.**

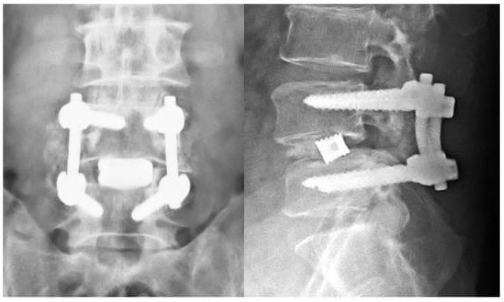
| LENKES grading | Operation procedure | | | | Total | |
|---|---|---|---|---|---|---|
| | PLF | | TLIF | | | |
| | N | % | N | % | N | % |
| **Grade A** | 57 | 91.94 | 68 | 87.18 | 125.0 | 89.29 |
| **Grade B** | 1 | 1.61 | 2 | 2.56 | 3.0 | 2.14 |
| **Grade C** | 1 | 1.61 | 2 | 2.56 | 3.0 | 2.14 |
| **Grade D** | 3 | 4.84 | 6 | 7.69 | 9.0 | 6.43 |
| **Total** | 62 | 100 | 78 | 100 | 140 | 100 |

Chi-square = 0.817, df=3, p=0.845, not significant.

**Table 6: Association between BSF scale and operation procedure.**

| BSF scale | Operation procedure | | | | Total | |
|---|---|---|---|---|---|---|
| | PLF | | TLIF | | | |
| | N | % | N | % | N | % |
| **BSF 1** | 2 | 3.23 | 3 | 3.85 | 5 | 3.57 |
| **BSF 2** | 3 | 4.84 | 7 | 8.97 | 10 | 7.14 |
| **BSF 3** | 57 | 91.94 | 68 | 87.18 | 125 | 89.29 |
| **Total** | 62 | 100.00 | 78 | 100.00 | 140 | 100.00 |

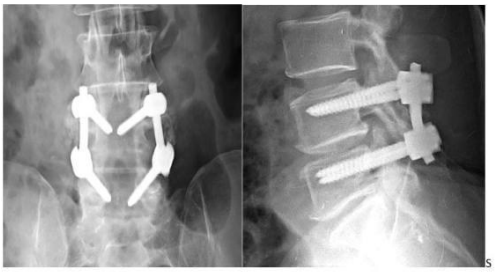
Chi-square = 0.952, df=2, p=0.621, not significant.



Post Op TLIF

**Figure 3: Post operative X-rays of TLIF.**

The results indicate the significance of association between LENKES grading and operation procedure. The analysis of chi-square shows no significant difference in the LENKES grading according to the operation procedure (Chi-square=0.817, p=0.845). The results also indicate the significance of association between BSF scale and operation procedure. The analysis of chi-square shows no significant difference in the BSF scale according to the operation procedure (Chi-square= 0.952, p=0.621).



Post Op PLF

**Figure 4: Post operative X-rays of PLF.**

## DISCUSSION

We have retrospectively analysed a case series of 140 TLIF and PLF patients. Several non-randomized studies and one small randomized controlled trial comparing TLIF and PLF, suggests that PLF is associated with fewer complications, less blood loss, shorter operative time and hospital duration, leading to lower health care costs and an improvement in quality of life but the reoperation rate was statistically higher for PLF.[3] In the last decade, with various studies superior results of interbody spinal fusion has increased steeply, and with the increase in life expectancy of population this is expected to rise further. Therefore we attempted to verify these presumed advantages of TLIF over PLF.[4] In contrast to the literature we did not find difference in estimated intraoperative blood loss or duration of hospitalization between both procedures. A shorter surgical time was observed in the PLF group compare to TLIF group which was not significant. Complications like superficial infection were seen in 3 cases of PLF group and 2 cases of TLIF group. They were treated with appropriate antibiotics and resolved completely. There was one patient of hardware failure in PLF group however patient was clinically asymptomatic. With both the techniques, there is significant reduction in back as well as leg pain post operatively. Comparing our series to other reported series we observed some similarities and some differences. Audat et al compared PLF, PLIF, and TLIF for degenerative disc disease in 81 patients between 2003 to 2006 and found that no significant difference existed between the three groups in terms of clinical, radiological outcome and complications.[5] However, the best radiological outcome was found in patients treated with TLIF, with Radiographic fusion rates 91.9% at the end of 3 years follow-up. Comparing to our study we also found good clinical outcome &Radiographic fusion in both TLIF group and PLF group with slightly better radiographic fusion in TLIF group at the end of 36 months. Høy et al studied 100 patients in prospective randomized clinical study from November 2003 to November 2008 to analyse outcome, with respect to functional disability, pain, fusion rate and complications of patients treated with TLIF was compared to instrumented PLF alone in low back pain patients.[6] They concluded that TLIF did not significantly improve functional outcome in patients compared to PLF. Both

groups improved significantly in all categories compared to preoperatively. We found similar results in our present study. Videbaek et al did Prospective randomized clinical study with a 5 to 9 year follow-up period to analyse the long-term outcome with respect to functional disability, pain and general health of patients treated by means of circumferential lumbar fusion in comparison with those treated by means of instrumented posterolateral lumbar fusion alone from April 1996 to November 1999 a total of 148 patients were included in study.[7] They found 5 to 9 years after surgery; the circumferentially fused patients had a significantly improved outcome compared with those treated by means of posterolateral fusion. There results emphasize the superiority of circumferential fusion in the complex pathology of the lumbar spine. In our present study we compared TLIF which is a type of circumferential fusion with PLF. Follow up of this study is 5 to 9 years and follow up of our study is 3 years which is shorter in duration and results of our study shows highly significant post-operative improvement in clinical outcome and radiological outcome in both PLF group and TLIF group. However we are assuming superiority in long term results of TLIF over PLF; as TLIF enables stabilization of the deranged motion segment, neural decompression, reconstruction of the disc height, restoration of the sagittal plane translation and rotational alignment better then PLF. We observed significant reduction in the post-operative VAS score, ODI score compare to pre-operative scores in both TLIF & PLF butthe mean difference between pre-operative and post-operative Coronal angle in PLF group was 11.419 (±1.675) and in TLIF group it was 8.705 (±2.058) and the mean difference between pre-operative and post-operative Lumbar Lordosis angle in PLF group was -12.226 (±2.412) and in TLIF group it was -10.000 (±2.156); which shows radiologically TLIF gives better correction in sagittal balance and rotational alignment compare to PLF. Because of this we assume that there will be better clinical and radiological outcome in TLIF group in long term.

***Limitations***

This study has several limitations. First this is monocentric retrospective study; secondly our follow up period is short & also the sample size of 140 patients is less to form a definitive conclusion. A randomized controlled trial of sufficient sample size with longer follow up is needed for further evaluation.

## CONCLUSION

We conclude that in the short term duration of our study, both the procedures done with proper technique in duly indicated patients shows satisfactory clinical outcome. However, radiologically TLIF patients had better outcome. We expect better outcome in long term with TLIF compared to PLF. In presence of insignificant blood loss, surgical duration and better $360^0$ fusion TLIF is preferred over PLF.

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