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Comparative Assessment of Salivary Endothelin-1 Levels In Periodontitis Subjects Following Non-Surgical Periodontal Therapy (Nspt) With Adjunctive Photobiomodulation And Nspt Alone: A Prospective Interventional Study

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ABSTRACT

Lumbar interbody fusion for degenerative spondylolisthesis usually entails sacrificing one or both of the facet joints when approached posteriorly. The 'facet preserving' PLIF described by Cloward carries an advantage of preserving bone stock, compared to the most widely used Transforaminal Lumbar Interbody Fusion technique.

Aim: To Compare Posterior Lumbar Interbody Fusion and Transforaminal Lumbar Interbody Fusion techniques.

Settings and Design: Cohort study.

Methods and Material: We compared the complications, clinical and radiological outcomes of PLIF (n = 25) and TLIF (n = 50). Outcome measures included Oswestry Disability Index (ODI) , modified Japanese Orthopaedic Association score (mJOA), and visual analog score (VAS). Radiographs were repeated at six months. Peri-operative outcomes like blood loss (ml), operative time (minutes), length of stay in hospital (days), incidence of surgical complications were also recorded.

Statistical analysis: t-test was used for the analysis of continuous data with normal distribution and Mann-Whitney U-test for data with non-normal distribution. Chi-square test was performed for categorical variables with groups. Pearson correlation done between two continuous variables. Differences were considered significant at $P<0.05$.

Results:Average follow up time for Posterior Lumbar Interbody Fusion technique was 28 months compared to 25 months for Transforaminal Lumbar Interbody Fusion technique (P value 0.52). Operative time was significantly lower in Posterior Lumbar Interbody Fusion technique (P value < 0.001). Complication rate (P value 0.132), clinical and radiological outcomes were comparable in both the techniques.

Conclusions:Both Posterior Lumbar Interbody Fusion and Transforaminal Lumbar Interbody Fusion technique yield comparable results

techniques

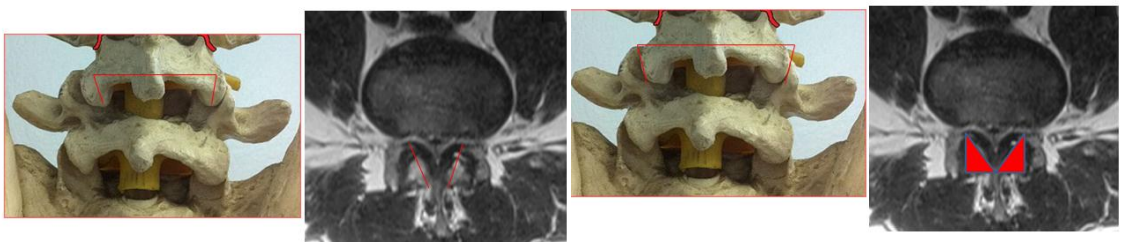
Subjects and Methods:

A total of 75 patients diagnosed with L4-L5 degenerative spondylolisthesis (DLS) were operated and included in this retrospective study. All procedures performed in the study were conducted in accordance with the ethics standards given in 1964 declaration of Helsinki, as revised in 2013. Only patients with single level L4- L5 DLS who underwent fusion with a follow up of at least six months were included. Exclusion criterion included history of previous spine surgery, trauma, post infective sequel, and multilevel spine pathology. All procedures were performed by surgeons with over ten years of surgical experience. The choice of procedure (PLIF or TLIF) was left to the discretion of the operating surgeon.

Surgical access to the intervertebral disc was gained from posterior. The patient is positioned in a prone position on a Relton hall frame. An open midline approach with bilateral muscle strip dissection approach was used to access the posterior column of the vertebral body. A laminotomy was performed medial to the facet and the dura retracted to expose the disc space. The endplates and disc space were then prepared to allow implant/spacer insertion. Fusion procedure was performed with one group undergoing PLIF technique involving oblique osteotomies of bilateral inferior facets, while the other group with TLIF technique had removal of bilateral inferior facets as shown in (Figure 1 and 2)

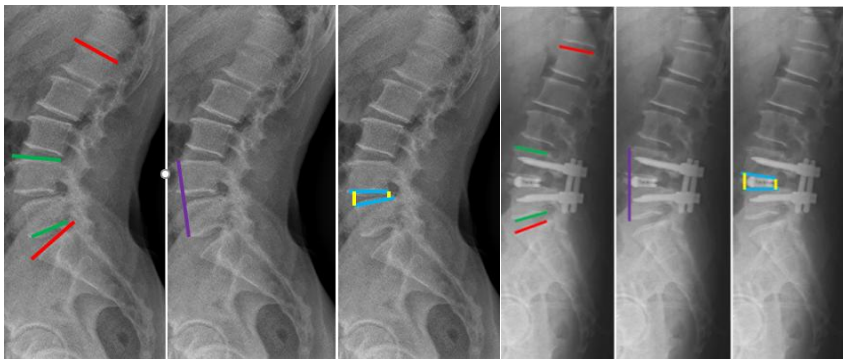
Facet sparing/preserving- Oblique ostetomies of inferior facet

Facet sacrificing- Inferior facet removal



Data collection as performed by one spine fellow and two orthopaedic residents, and supervised by one of the consultant spine surgeons. The following data was gathered for analysis: Demographics, ODI, mJOA,VAS (Back pain)– Preoperative and postoperative score, length of hospital stay, requirement of steroid medications for postoperative radicular pain, intra-operative adverse events including dural and /or nerve root injuries, operative time, blood loss. Postoperative adverse events were also recorded.

Radiographic evaluation included pre-operative and post-operative radiographs atminimum of six months to assess lumbar lordosis,[4] segmental lordosis,[5] disc and segmental height,[6] slip angle, translation,[7] and cage migration. Lumbar lordosis, segmental lordosis, segmental height, and disc height were measured as shown in figure 3 and 4.It was difficult to measure disc height change on postoperative radiographs due to the presence of interbody implants, and therefore we elected to measure the anterior segmental height and posterior segmental height to determine any height loss. The degree of spondylolisthesis was graded as per the Meyerding technique



Pre-operative X ray

Lumbar and segmental Lordosis

Segmental height

Slip angle, Anterior and Posterior height

Post-operative X ray

Lumbar and segmental Lordosis	Segmental height	Slip angle, Anterior and Posterior height

Slip reduction wasdefined as the difference between the pre- and postoperative spondylolisthesis.[8]

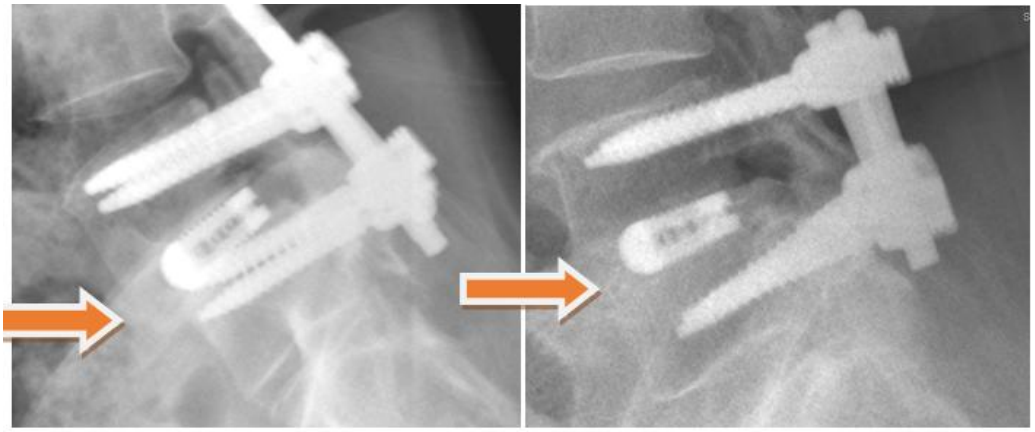
Fusion was assessed using Bridwell's grading.[9]

Grade I: fused with remodeling and trabeculae present,

Grade II: graft intact but not fully remodeled and incorporated, with no lucencies above or below,

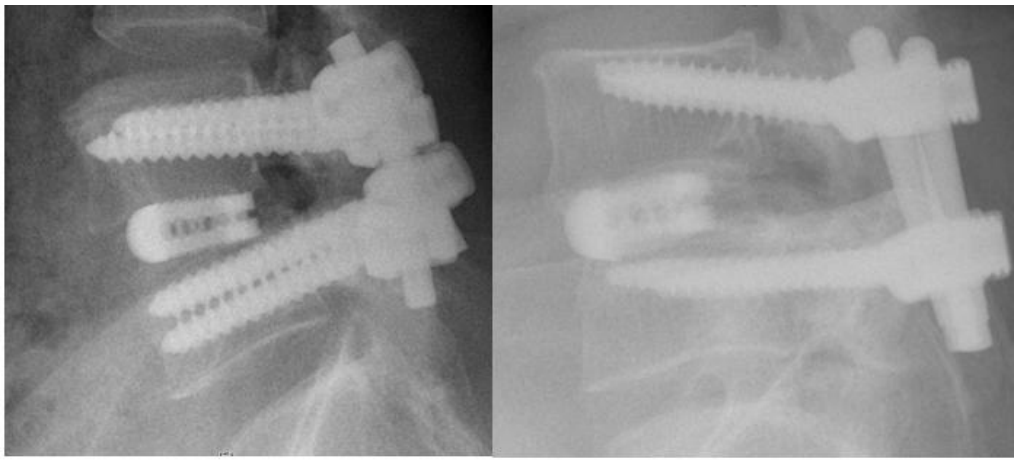
Grade III: graft intact but with a definite lucency at the top or bottom of the graft, and

Grade IV: definitely not fused, with resorption of bone graft and collapse. Both grade 1 and 2 were considered radiographic signs of fusion as shown in figure 5 and 6



PLIF **TLIF**

Grade 1 fusion seen in both techniques



PLIF **TLIF**

Grade 2 fusion seen in both techniques

Statistical analysis: t-test was used for the analysis of continuous data with normal distribution and Mann-Whitney U test for data with non- normal distribution. Chi-square test was performed for categorical variables with groups. Pearson correlation done between two continuous variables. Differences were considered significant at $P<0.05$. All the statistical analyses will be performed using SPSS 25.0.

RESULTS:

Table 1 and 2 shows the demographics and clinical characteristics of patients in both the groups. A total of 131 patients were identified during the study period, of which adequate follow up was available for 75 patients, who were then enrolled for the study. There were 25 patients in the PLIF and 50 patients in the TLIF group.The age distribution was comparable with a female preponderance in both the groups. The preoperative disability as measured by VAS was higher in the PLIF group, however the postoperative scores were not statistically different between the groups. There were also no differences between the two groups in terms of post operative clinical outcome assessed by ODI and mJOA scores(Table 2). The surgical operative time was significantly lower in the PLIF group compared to TLIF group, however blood loss and length of hospital stay was comparable in both groups.

Radiographically, both the groups had a post operative improvement in lumbar lordosis, segmental lordosis, disc height, segmental height, slip angle, translation. However, when these parameters were compared within the two groups there was no difference (P value > 0.05). Fusion as assessed by Bridwell's criteria showed a comparable rate in both groups (92% and 96% in PLIF and TLIF groups respectively, P value 0.21)

There was no difference in the overall complication rate, surgical site infection, radicular pain, neurological deficits, dural tear, in both the groups (P value > 0.05). Cage migration was seen in 2 patients in the PLIF group, but the difference between the groups was not statistically significant. The migration was asymptomatic in both patients.

Table 1 Demographics

	PLIF (%)	TLIF (%)
Number of patients	25 (33)	50 (67)
Age (mean)	56	56
Gender *male*	11 (44)	18 (36)
Female	14 (56)	32 (64)

Table 2Clinical and operative data

	PLIF (%)	TLIF (%)	P value
Duration of follow up (months)	28	25	0.524
VAS (mean) pre-operative	6.4	5.7	**0.014**
post-operative	1.7	1	0.107
ODI (mean) pre-operative	64	63	0.892
post-operative	18	16	0.657
mJOA (mean) pre-operative	15	18	0.644

post-operative	22	23	0.587
Operative time	137	180	**0.000**
Blood loss (ml)	275	282	0.808
Length of stay in hospital (days)	5	5	>0.05

Table 3 Pre-operative and post-operative radiographic parameters

	PLIF (mean)	TLIF (mean)	P value
Anterior Disc Height Pre-Op**(mm)**	78	80	0.860
Posterior Disc Height Pre-Op**(mm)**	68	71	0.495
Anterior Disc Height Post Op**(mm)**	93	104	0.178
Posterior Disc Height Post-Op**(mm)**	72	74	0.692
Lumbar Lordosis Pre-Op**(degree)**	40	45	0.166
Lumbar Lordosis Post Op**(degree)**	46	49	0.260
Segmental Lordosis Pre-Op**(degree**)	12	13	0.594
Segmental Lordosis Post Op**(degree)**	17	15	0.349

Table 4 Pre-operative and post-operative radiographic parameters

	PLIF	TLIF	P value
Slip Angle Pre-Op **(degree)**	1.5	1.8	0.883
Slip Angle- Post Op **(degree)**	4.6	5.3	0.481
Translation Pre-Op**(%)**	19	15	0.109

Translation Post-Op**(%)**	10	10	0.638
Total Anterior Disc Height Loss **(mm)**	4	4.5	0.835
Total Posterior Disc Height Loss (mm)	3	2.5	0.346
Fusion (%)	92	96	0.211

Table 5 Complications

	PLIF	TLIF	P value
Overall (%)	5 (20)	4(8)	0.132
SSI (%)	4 (16)	3 (6)	0.160
Cage migration (%)	2 (8)	0	**0.043**
Radicular pain (%)	1 (4)	0	0.155
Neurodeficit(%)	1(4)	0	0.155
Dural tear(%)	1(4)	1(2)	0.62

1. DISCUSSION:

PLIF and TLIF have become established techniques for the treatment of degenerative instability of the lumbar spine, with TLIF being the increasingly preferred option by most surgeons, in view of lesser neural manipulation. However, TLIF requires resection of one/both facet joints to gain access to the disc space. The PLIF offers a wider access and at the same time offers the benefits of bone preservation. The present study was therefore intended to serve as a comparison of the PLIF and TLIF techniques of posterior lumbar fusion.

The mean age of the patient in both the groups was 56 with a female pre-ponderance. The mean pre-operative ODI score, mJOA score and VAS score in both groups were comparable were 18 vs 16, P value0.657, 22 vs 23 (P value 0.587), and 1.7 vs 1 (P value 0.107) respectively. These results are comparable with previous studies (Lan T et,[10] Fan G et al,[11] Audat Z et al,[12] BarbarawiMet al[13]) among patients who underwent PLIF/TLIF study. Therefore, clinical outcome were comparable in both the groups. The surgical technique used in both groups was comparable with the exception of facet joint retention in the study group, and this did not seem to affect clinical outcomes as far as VAS and ODI were concerned.

We found no difference in radiological outcome between both the groups when we measured lumbar lordosis, segmental lordosis, disc height, segmental height, slip angle and translation. Also there was also no significant loss of anterior disc height in either group and implant construct was found to be stable sparing the sagittal and coronal balance.

Our results showed a comparable rate of fusion between the two techniques (92 vs 96%, P= 0.62). Previous reports comparing PLIF and TLIF have reported fusion rates of 67 to 100% (Brantigan et al,[14] Kim et al,[15] Rezk et al[9]). Although the operative time in the PLIF technique was significantly less when compared with TLIF group, intraoperative blood loss and length of hospital stay was not significantly different between the two groups. Previous studies (Sakeb et al,[15] Liu J et al,[16] Lee N et al[17]) have reported a higher blood loss was more associated with PLIF than TLIF.

The overall reported complication rates of PLIF and TLIF is 8% to 80%.[19] In our study the complication rate seen in PLIF group was 20% and 8% in the TLIF group. One dural tear was noted in each of the two groups (4% vs 2%) and this

difference was statistically insignificant (P value 0.162). Neither of the two patients required a second procedure to treat the dural injury. Previous studies have reported rates of dural injuries varying from 4.4 – 7.6% (Sakeb et al,[16]Rezk et al,[9] Goldsteinet al[20]) with a possibly lower rate of dural injuries in TLIF as compared to PLIF.

The incidence of intraoperative neural injury has been reported to be higher in PLIF than TLIF (7.8% vs 2%,Mehta et al[21]) with the proposed causative mechanisms including a higher amount of root traction during PLIF and/or root ischaemia. Simmons et al[21] reported new postoperative motor deficits in 2% of 500 patients who underwent PLIF.Our study showed postoperative neurological deficit was seen in one patient who was in the PLIF group which was statistically insignificant (P value > 0.155). This patient was found to have the deficit due to screw malposition, and this was eventually treated with screw exchange. Matsui et al[22] suggested that decreased retraction time and tension can lead to a lower rate of ischemic injury to nerve root and careful neural protection during interbody preparation and interbody implant placement can reduce neurologic injury in these patients.

Incidence of infection reported for a lumbar interbody fusion is 0 to 9%[19] with at least two studies reporting higher infection rates in patients undergoing PLIF rather than TLIF. Lee N et al[18] (2017) reported SSI's of 7.2% in PLIF and 5% in TLIF patients. Similarly, Liu J et al[17] had a SSI of 9% in PLIF and 5% in TLIF patients.

Our study had a total of six deep infections, although there was no statistical difference in surgical site infection (SSI) rates among the PLIF and TLIF groups. However, three of the four patients in PLIF group with SSI had co-existent diabetes mellitus. Deep infections were managed by surgical re-exploration, wound washout, followed by ten weeks of antibiotics as per the culture and sensitivity reports.

Our study revealed two instances of interbody cage migration in the follow up period. Both these patients were in the PLIF group, and both were treated with cage exchange and additional compression posteriorly across the pedicle screws. Although cage migration can be a result of undersizing the implant, we believe that preserving the facet joints on both sides may limit the compression of the facets possible, which also serves to close down the posterior disc space

There are, however, literature reports of similar rates of cage migration in both PLIF and TLIF. Sakeb et al[16] in their retrospective study compared 52 cases of PLIF with 50 cases of TLIF . Backache and pain leg pain was assessed by Oswestry disability index and visual analogue scale. Radiological parameters - disc height, foraminal height, lordotic angle, and slip reduction), stability (using Posner criteria), fusion (using Hackenberg criteria), and overall functional outcome (using MacNab'scriteria) was compared and patients were followed up of one year. Both techniques were effective in relieving symptoms, achieving structural restoration, stability, and fusion . They found one case of cage migration in both PLIF (1.92%) and TLIF group (1%)

Our study showed three patients with no radiological signs of union, all of whom had < 12 months postoperative follow up; two of these were in the PLIF group and one in TLIF group. All the patients had a stable implant construct with no loss of segmental height, lumbar lordosis, anterior disc and segmental height in successive follow up X rays. As these patients had a follow up of less than twelve months post-operatively they were not labelled as having nonunion/pseudoarthrosis, and we expect them to progress to fusion uneventfully.

The reported rates of established pseudarthrosis after PLIF or TLIF is 2-5%,[19] with higher rates reported with TLIF

2. LIMITATIONS

This was a level three study with no randomization of patients done with one surgeon performing PLIF technique and three surgeons performing TLIF technique. The sample size in the study was also underpowered. Sufficient sample size and more long term follow up is desirable in future studies.

3. CONCLUSION :

In this study comparing PLIF and TLIF techniques for posterior lumbar fusion, we found clinical and radiological outcomes were comparable. We therefore propose that the bone preserving advantages of the facet-preserving technique make it a more physiological option for patients being considered for lumbar fusion.

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