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ORIGINAL STUDY

Interbody fusion versus posterolateral fusion in treatment of low grade lytic spondylolisthesis

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This is a prospective randomized study to compare the outcome of two widely used fusion methods ; posterior lumbar interbody fusion (PLIF) and posterolateral fusion (PLF) in treatment of adult low grade lytic spondylolisthesis to know which is ideal.

40 consecutive patients with single level lytic spondylolisthesis were randomly divided into two treatment groups when undergoing surgery. Blood loss and operative time were recorded. Patients were postoperatively assessed using JOA score. Union rate was assessed. They were followed up for a minimum of 2 years.

No differences were found between both groups as regards operative time and blood loss. At 2 years follow up, statistically significant improvement in JOA scores were found in both fusion groups. However, no difference could be found between the groups. Both groups showed solid fusion with no evidence of non-union in all cases.

Both methods appear to be equally effective in treatment of the condition.

Keywords : Interbody Fusion ; Posterolateral Fusion ; Low Grade Lytic Spondylolisthesis.

INTRODUCTION

Lytic spondylolisthesis is a widely-spread condition with incidences as high as 5% being reported based on autopsy studies *(15)*. It has been graded based on the amount of vertebral subluxation in the sagittal plane as either low grade or high grade *(17)*.

Although it may be asymptomatic and found incidentally *(11,12)*, many suffer from low back pain, leg pain and considerable disability from the condition. When conservative measures fail, patients may resort to surgery *(6)*.

Following decompression of the neural elements, fusion of the affected segment is usually performed. Posterolateral fusion has long been considered the gold standard for surgical treatment of spondylolisthesis in adults *(10,14)*. Superior results have subsequently been reported with posterior interbody fusion using cages, however, inconsistency in reported outcomes have deferred from a consensus being reached about the best fusion method *(2,5,20,22)*.

The aim of this study was to evaluate the two fusion techniques and try to reach a conclusion, if

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such was possible, as to which was a better option in fusion of lytic spondylolisthesis.

MATERIAL AND METHODS

In a prospective randomized study, 40 consecutive adult patients with either grade 1 or grade 2 single level lytic spondylolisthesis were operated upon by the same surgeon. All of them were symptomatic and did not respond to conservative measures for at least 6 months. Posterior pedicle screws and rods instrumentation (LEGACY, Medtronic, USA) was used in all of them. Decompression was performed using standard Gill's procedure *(9)*. As for the fusion method, patients were randomly divided into two equal groups. In group 1 (n20), PLF was performed where bone graft was placed between the decorticated transverse processes. In group 2 (n20), PLIF was performed using two PEEK cages (Stryker, USA) inserted from each side following near total discectomy and end plate decortication. Morselized cancellous bone was impacted in the disc space prior to insertion of the cages helping as a guide to confirm fusion. Bone graft was obtained from iliac bone in both groups and mixed with local bone from the laminae.

Patients with previous spine surgery, compression fracture or instability at the adjacent segment or requiring multiple level surgeries were excluded from this study.

The two groups were compared as regards their age, sex, body weight, and level of spondylolisthesis. They were clinically assessed using the JOA score. The patients were followed up for a minimum period of at least 2 years. JOA score was collected and compared at 2 years postoperatively. Fusion at final follow up was confirmed using radiographs. Postoperative complications were recorded.

Solid union was determined by detecting bony trabecular continuity on plain radiographs and CT (between the transverse processes in PLF group and across the disc space in PLIF group). Screw breakage was also considered a sign of non-union.

Statistical analysis was performed using SPSS v13.0. Wilcoxon signed ranks test was used to compare multiple readings of the same variables. Chi-square (c^2) test was used to compare frequency of qualitative variables among the different groups. Spearman's correlation test was used for correlating non-parametric variables. For all tests, p value less than 0.05 was considered significant and less than 0.001 highly significant.

RESULTS

No statistical difference was found among both groups as regards age, sex, body weight and preoperative JOA score (either in individual parameters or total score). L5/ S1 was operated upon in 28 patients (group 1 = 13, group 2 = 15), L4/L5 in 12 (group 1 = 7, group 2 =5) with no significant difference between both groups (Table 1).

The mean blood in PLF was 1000ml, in PLIF 1100ml. The mean operative time was 95 minutes and 105 minutes respectively. There were no significant difference among both groups as regards both parameters.

At two years follow up, in both groups, there were statistically highly significant difference in improvement of JOA score. On comparing both fusion techniques, the outcomes showed no significant difference. There was no difference in

Table 1. — Demographic data and Preoperative JOA

	PLF (n = 20)	PLIF (n = 20)	test result	p value
Age (years)	44.1±7.34	44.15±6.9	0.31	0.75
Male : female	5:15	6:14	0.13	0.72
Disc level **L5-L1** **L5-S1**	 13 7	 15 5	 0.48 0.48	 0.49 0.49
Weight (Kg)	74.95±10.5	72.2±9.25	0.95	0.36
Preoperative JOA Score	15±1.9	14.15±1.8	1.28	0.21

Table 2. — Preoperative and postoperative JOA scores in both groups

	PLF			PLIF			
	Pre-op	*Post-op*	*Within group P-value*[1]	*Pre-op*	*Post-op*	*Within group P-value*[1]	*Between group P-value*[2]
Total JOA score	15±1.9	23.9±1.9	0.000	14.15±1.8	25.15±1.4	0.000	0.29
Back pain	0.6±0.5	2.2±0.6	0.000	0.4±0.5	2.05±0.6	0.000	0.51
Leg pain	1.25±0.55	2.85±0.37	0.000	1.4±0.5	2.7±0.47	0.000	0.43
ADL[3]	7.2±1.2	10.2±1.2	0.000	6.35±1.4	12±1.03	0.000	0.16

postoperative JOA score. Both methods improved back pain, leg pain and disability without differences in outcome between both groups (Table 2).

As for the complications, transient foot drop was noted in two cases in PLIF group which had fully recovered by the time of final follow up. A single case suffered from infection in iliac graft site in PLF group. All patients from both groups showed radiographic evidence of fusion with obvious bridging bone trabeculae across the vertebrae and no signs of pseudoarthrosis as screw breakage.

DISCUSSION

Often PLIF is assumed to be superior to PLF. Its theoretical benefits include anterior column support of the spine, indirect nerve root decompression achieved by disc height restoration and better restoration of vertebral alignment both sagittaly and coronally *(7)*. The removed disc, which is usually degenerated, is a potential source of axial pain *(18)*. Excessive paraspinal muscles dissection and injury in PLF is thought to add to the back pain.

Fusion is assessed radiologically with greater feasibility in PLIF when compared to PLF, and the wide fusion area provided in PLIF presumably increases chances of sound fusion. Higher fusion rates have been reported with PLIF. Screw breakage or loosening, which could be due to pseudarthrosis, are also reported to be less with PLIF due to the better fusion rates and anterior support *(5, 16, 18)*.

PLIF is reported to be the choice in high grade spondylolisthesis *(1)*. Release provided by discectomy with disc space distraction has been shown to reduce the vertebral slip thus restoring the sagittal alignment. The obtained lumbar lordosis provides superior fusion biomechanically as well as relieving any hamstring tightness *(3,5,7,22)*. Thus in high grade spondylolisthesis PLIF is the treatment of choice.

However in low grade spondylolisthesis, PLF is the preferred method for many surgeons due to its satisfactory results while being less demanding and with relatively lower risks. Traditionally, PLIF is associated with more blood loss and longer operative times. Retraction of the nerve root while inserting the cage carries with it higher risk of postoperative drop foot and radicular pain. Furthermore the theoretical advantages, in many reports, do not seem to reflect on patient outcome and satisfaction *(2,6,8,10,14)*.

The present analysis comparing both fusion methods revealed that there are no significant difference in clinical outcomes between them, with both being effective in reducing back and leg pain. In addition, neither amount of blood loss, operative time nor complications in PLIF exceeded that of PLF.

The continuous improvements in the interbody devices and their methods of application, refining of the surgical techniques to decrease time and amount of dural sac retraction as well as the meticulous control of veins overlying the discs are all assumed to have reduced blood loss, surgery time and nerve root related problems in PLIF. In addition, wider dissection of the paraspinal muscles is required in PLF to expose the transverse processes as well as proper decortication to provide adequate fusion bed when compared to PLIF.

Many studies have recorded the impact of fusion rate on clinical outcome. Better functional outcome and patient satisfaction has been reported by Yu et al. *(21)* with successful fusion in a retrospective study of PLIF in spondylolisthesis as well as others *(4,13)*. Theoretical advantage of providing better

fusion rates in PLIF appear to provide superiority in clinical outcome. However, the results are not conclusive and fail to show difference as in our current study. Fusion was achieved in all cases in our series. This could be attributed to meticulous decortication and preparation of the fusion bed with generous bone grafting. However in larger series, a difference in fusion rates might be recorded.

Another issue on table is that of adjacent segment disease after fusion and its effect on long term clinical outcome. In a handful of experiments on human cadavers, biomechanical stresses and resultant changes are more extensive in PLIF *(7)*. PLF may be preferred to PLIF about this matter yet clinical studies have yielded contradicting results. The prevalence as well as time elapsed for adjacent segment disease showed no difference among the different fusion methods *(13,19)*. Our study focused on short term outcome and longer follow ups are needed to determine whether the fusion methods differ in relation to adjacent segment disease.

CONCLUSION

The present analysis revealed that there were no significant differences in clinical outcome between the two surgical interventions, and both were effective in reducing back and leg pain. However, it may be surprising that PLIF showed a non-significant trend toward a lower complication rate and that the amount of blood loss and duration of operating time of PLIF did not exceed those of PLF.

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