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Clinical Article

Comparison between Posterior and Transforaminal Approaches for Lumbar Interbody Fusion

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Objective : Posterior lumbar interbody fusion(PLIF), the current leading method of pedicle screw fixation combined with interbody fusion via posterior route, sometimes requires too much destruction of the facet joint than expected especially for the patient with a narrow spine. On the other hand, tranforaminal lumbar interbody fusion(TLIF) technique provides potential advantages over PLIF and can be chosen as a better surgical alternative to more traditional fusion methods in certain surgical conditions.

Methods : From October 1999, 99 PLIF and 29 TLIF procedures were done for the patients with spinal stenosis and instability. Radiological data including the interpedicular distance and the size of the pedicles as well as the clinical parameters were collected retrospectively. The degree of resection of the inferior articular process was compared with the interpedicular distance in each patient who received PLIF.

Results : No significant differences were found between PLIF and TLIF regarding the operation time, blood loss, duration of hospital stay, or short term postoperative clinical result. There were no complication with TLIF, but PLIF resulted in 9(9.1%) complications. During PLIF procedure, all patients(n=24) except one with the interpedicular distance shorter than 27mm required near complete or complete resection of the inferior articular processes, whereas only 6(31.5%) of 19 patients with the interpedicular distances longer than 30mm required the similar extent of resection.

Conclusion : TLIF is better than PLIF in terms of the complication rate. The patient who had narrow interpedicular distance(<27mm) might be better candidate for TLIF.

KEY WORDS : Lumbar fusion · Posterior lumbar interbody fusion · Transforaminal lumbar interbody fusion.

Introduction

Posterior lumbar interbody fusion(PLIF) which was introduced by Cloward in 1953 and modified by Lin and others became now one of the most popular methods for posterior lumbar fusion[2,4,12,13]. Transforaminal lumbar interbody fusion(TLIF), as a modification of PLIF, was presented by Harm[6] in 1998. Because TLIF provides easier unilateral approach than PLIF, it allows lower incidence of perioperative complications with similar fusion rate. Furthermore, because the contralateral lamina is preserved, it has the additional advantage of easy reoperation, allowing more effective decompression for the foraminal stenosis, and less retraction of dura and nerve root. The purpose of our study is to compare unilateral PLIF with unilateral TLIF regarding the indications, the structural differences of the spine, the techniques, operation time, perioperative complications, and the patients' satisfaction.

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Materials and Methods

Patients and radiographic assessment

From October 1993 to January 2004, 99 and 29 patients underwent PLIF and TLIF with pedicle screw fixation respectively. All of them had more than a month of disabling low back pain with or without leg pain refractory to various conservative treatment. They were 53 men and 75 women.

All patients took the magnetic resonance imaging and/or postmyelographic computed tomography to assess the extent and location of the stenosis, concomitant other spinal diseases, and presence of facet joint degeneration. Simple X-rays were also taken to evaluate the spinal instability.

All patients were operated on by the same operator. Mean postoperative follow up period of PLIF was 20.2±10.06(6-47) months, and that of TLIF was 10.4±4.78(6-20) months.

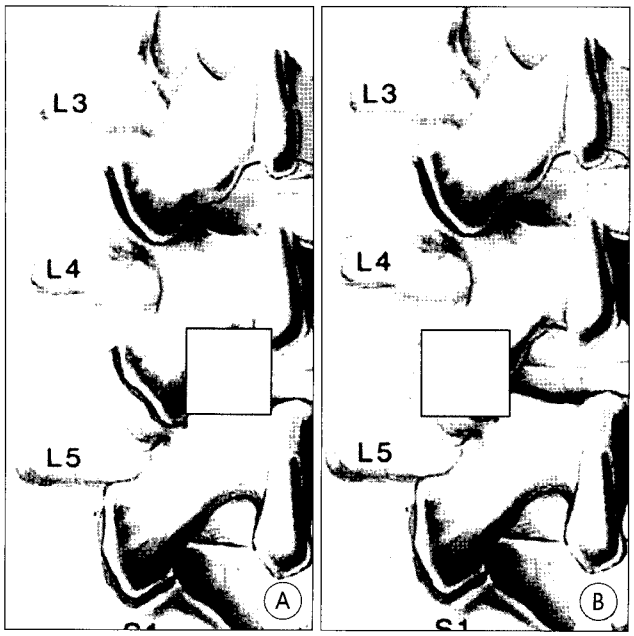

Fig. 1. Site of bony resection in posterior lumbar interbody fusion(A) and transforaminal lumbar interbody fusion(B).

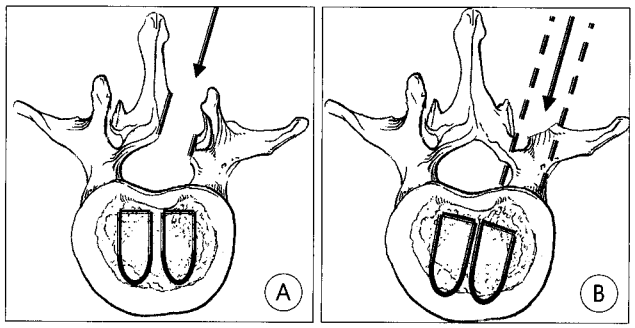

Fig. 2. The entry angles and relative position of the cages of posterior lumbar interbody fusion(A) and transforaminal lumbar interbody fusion(B).

Operative techniques-Transforaminal Lumbar Interbody Fusion

The patient was placed prone on a suitable spinal frame. A standard unilateral posterior midline approach was done to gain access to the vertebrae[8,19]. Careful dissection was performed down to the tip of transverse process without any injury to the supraspinous and interspinous ligaments. The paraspinous muscles were subperiosteally splitted to expose the dorsal aspect of the laminae. The inferior articular process and superior end of superior articular process of one side were resected.

Having nerve root carefully identified and protected, a near complete discectomy, endplate decortication, and knocking off endplate osteophytes were performed in turn. The disc space was distracted to insert bone chip filled carbon cage. Unlike PLIF, T-LIF usually required near total (>75%) facetectomy but complete facetectomy was not always necessary. The sites of the entries of PLIF and TLIF are illustrated in Fig. 1.

The inserted cage was pushed away to the contralateral side to make a room for the second cage. Since the entry of TLIF was more lateral to that of PLIF, the displaced cage tend to be laid down rather obliquely. The second cage was inserted and embedded lateral to the first one(Fig. 2).

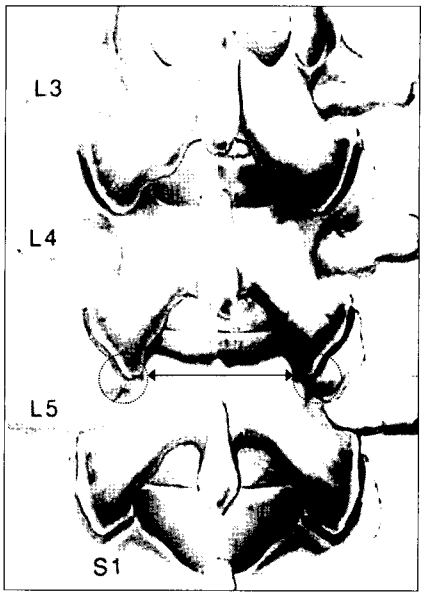

Fig. 3. Measuring the interpedicular distance.

The contralateral facet was exposed for pedicle screw fixation via interfascial approach. After the pedicle screw fixation and compression, the rod was contorted for the physiologic lumbar lordotic curve and inserted. After placing a closed-suction drainage catheter in the operative field, the wound was closed in layers.

Operative techniques-Posterior Lumbar Interbody Fusion

PLIF was performed by the standard fashion as previously reported[11,12]. The authors, however, chose unilateral route for insertion of two cages in all patients. When unilateral PLIF was adopted to the patient with too short interpedicular distance, additional facetectomy was often unavoidable. If the interpedicular distance was long enough(>30mm), near total or total medial facetectomy was usually unnecessary(Table 4). Posterior segmental instrumentation was performed in all cases.

Study design

From October 1999 to January 2004, 99 PLIF and 29 TLIF procedures were performed unilaterally by the same operator. The surgical candidates were the patients with degenerative disc diseases, central disc herniation, and spondylolisthesis. The authors routinely performed PLIF for the first 67 patients at the beginning of this period. After the introduction of TLIF technique, we performed either TLIF or PLIF.

Data regarding the amount of blood loss, the operative time, and

Table 1. Clinical parameters of posterior lumbar interbody fusion(PLIF) and transforaminal lumbar interbody fusion(TLIF)

	PLIF	TLIF
Age(years)	54(18-20)	57(40-72)
Sex(M : F)	43 : 56	10 : 19
Operative time(min.)	210(140-290)	198(120-260)
Transfusion(ml, cases/total. percent)	58(18/99,18%)	40(3/29,10.3%)
Postoperative hospital stay(days)	8.8(6-22)	7.8(5-12)

Table 2. Diagnoses and levels of fusion

	PLIF(n=99)	TLIF(n=29)
Diagnosis		
Degenerative spondylolisthesis	43(43.4%)	14(48.2%)
Isthmic spondylolisthesis	12(12.1%)	5(17.2%)
Spinal stenosis and instability	33(33.3%)	6(20.7%)
Postsurgical instability	7(7.1%)	4(13.8%)
Herniated disc and instability	4(4.1%)	0(0%)
Level		
L2-3	3	0
L3-4	8	5
L4-5	56	17
L5-S1	10	4
L3-4-5	13	2
L4-5-S1	5	1
L3-4-5-S1	2	0
L2-3-4-5	1	0
L2-3-4	1	0

the duration of hospital stay were collected for each procedure. The preoperative interpedicular distance was measured at the level of the lesion(Fig. 3). Patient's satisfaction was evaluated by modified grading system[5].

Results

Patients receiving PLIF included 43 men and 56 women with the mean age of 54(18~80) years. Postoperative follow up period of PLIF was 20.2(6~47) months, and TLIF was 10.4 (6~20) months. Data of the amount of blood loss, the operative time, and the duration of hospital stay are given in Table 1. The TLIF patients included 10 men and 19 women with the mean age of 57(40~72) years. Of the 99 PLIF procedures, 77 were one-level, 19 were two-level, and 3 were three-level fusions. Of the 29 TLIF procedures, 26 were one-level and 3 were two-level fusions. No significant differences were found between the two groups regarding the demographic variables. Diagnoses and fusion levels of each group are shown in Table 2.

The interpedicular distances of PLIF and TLIF groups are shown in Table 3. There were statistically significant differences of the interpedicular distance between male and female spines, but there were no significant differences among the control, PLIF and TLIF groups. During PLIF, however, the extent of medial facetectomy was significantly related to the interpedicular distance(Table 4). Of the 24patients with the interpedicular distances shorter than 27mm, 23(95.8%) underwent near total or total medical facetectomy, that is, near complete or complete resection of inferior articular process. On the other hand, only six(31.5%) of 19 patients with the interpedicular distances longer than 30mm underwent the near total or total medial facetectomy.

Postoperative outcome is shown in Table 5. There were no significant differences in patients' satisfaction according to the modified grading system[5]. PLIF had several postoperative complicaitons such as hematoma, discitis, root injury, transitional syndrome and screw fracture, whereas TLIF had none in this study.

Discussion

Interbody fusion provides several theoretical advantages over the other fusion techniques[1,2,4,13,15] by restoring the optimal disc height and sagittal balance, and creating a higher fusion rate by placing the graft under compression with an extensive blood supply from the adjacent vertebral endplates[1]. PLIF has gained its popularity for the spinal stenosis, instability, degenerative disc disease, spondylolisthesis, spondylolysis, and bilateral disc herniation[2,9,10].

Although PLIF is applicable in various cases, this technique has several complications and contraindications. In addition to the fact that its action for stability is in many parts dependent on the pedicle screw fixation[18,20], PLIF has some critical disadvantages like nerve root damage, dural laceration, epidural fibrosis, or neurogenic pain as a result of excessive dural

Table 3. The interpedicular distances of posterior lumbar interbody fusion(PLIF) and transforaminal lumbar interbody fusion(TLIF) group

	Control (n=60)			PLIF (n=99)			TLIF (n=29)		
	M (n=30)	F (n=30)	p Value	M (n=43)	F (n=56)	p Value	M (n=10)	F (n=19)	p Value
L4	27.3±2.74	26.7±2.74	0.000008	28.2±3.48	26.6±2.50	0.0079	28.9±4.86	27.2±3.45	0.0012
L5	31.4±3.30	31.0±3.06	0.0031	32.3±5.69	30.4±5.10	0.032	33.3±4.86	31.1±5.35	0.004

Table 4. The interpedicular distance vs extensive facetectomy during posterior lumbar interbody fusion(PLIF)

Interpedicular distance(mm)	Total cases(n=99)	Extensive facetectomy
<27	24	23(95.8%)
<30	56	44(78.6%)
>30	19	6(31.5%)

Table 5. Clinical outcome after posterior lumbar interbody fusion(PLIF) and transforaminal lumbar interbody fusion(TLIF)

	PLIF(n=99)	TLIF(n=29)
Outcome †		
Excellent/good	80(80.8%)	24(86.2%)
Fair	18(18.2%)	5(17.2%)
Poor/ very poor	1(1.0%)	0(0%)
Complications		
Reoperation(hematoma)*	2	0
Discitis	1	0
Root injury**	1	0
Transitional syndrome***	3	0
Screw fracture	2	0
Follow up period(months)	20.2(6-47)	10.4(6-20)

* Two patients with temporary root injury. ** Permanent root injury *** No corresponding symptoms † p=0.88>0.05

retraction. Cauda equina injuries were reported to occur in 19% of patients in one series with permanent nerve dysfunction in three among 465patients[13]. Ray reported 13 dural tears and a 10% incidence of transient foot weakness in his follow-up study of 236 patients treated by PLIF with threaded cage insertion[15].

The unilateral transforaminal posterior lumbar interbody fusion was developed to solve these problems. As the approach in TLIF technique is lateral to the vertebral foramen, the risk of neural damage from retraction is much reduced. Humphrey reported no complication with TLIF, whereas multiple complications were associated with the bilateral posterior approach[8]. We also had no complication with TLIF but had a few complications with PLIF(Table 5). Because some of these complications such as transitional syndrome or screw fracture might be categorized as a long term complication, relatively short follow-up period of TLIF is possibly insufficient to detect those complications, and therefore the superiority of TLIF in terms of low incidence of postoperative complications is debatable. The theoretical basis, however, can explain the lower incidence of long term complications in TLIF. Because TLIF preserves the posterior compartment more effectively than PLIF does, the transitional syndrome or screw fracture is less likely to occur.

It has been known that unilateral PLIF is very difficult due to the overlying cauda equina but we performed unilatral instead of bilateral PLIF to compare with unilateral TLIF. A useful modification, however, has been developed. In case when the interpedicular distance is not sufficiently long, medial facetectomy to a variable extent can facilitate the unilateral PLIF. Therefore, in the strict sense, unilateral PLIF of this study was PLIF with medial facetectomy to a variable extent. Regarding the operation time and the possibility of spinal instability, the unilateral TLIF is preferred to the unilateral PLIF with massive facetectomy unless the patient has severe spinal stenosis to be decompressed. Even though TLIF is superior to PLIF regarding less retraction of dura or conus medullaris and saving spinous processes that can affect the postoperative spinal stability[7,8,14,17], there are certain conditions when unilateral PLIF is better suited than TLIF. Those conditions include sufficient interpedicular distance for cage insertion and severe spinal stenosis.

When considering decompression for spinal stenosis only, TLIF is supposed to be less effective because it includes smaller laminectomy than PLIF which includes subtotal or total laminectomy. Therefore, the patients with moderate or severe spinal stenosis seems to be better candidates for PLIF than TLIF. Recent development of decompressive techniques made it possible to decompress contralateral side sufficiently through unilateral route in selected cases. On the contrary, TLIF is preferred for the foraminal stenosis, because facetectomy eventually widens the spinal foramen.

If the surgeon pays more attention to the interpedicular distance preoperatively, he or she will be able to decide which method to choose. If the interpedicular distance is shorter than 27mm, extensive facetectomy, which is the main part of TLIF, is frequently unavoidable to allow the cage to enter the disc space. When the interpedicular distance is longer than 30mm, PLIF can be chosen without damage of the pars interarticularis. In a group of patients with interpedicular distance shorter than 27mm, 95.8% of them underwent near complete or complete facetectomy during the PLIF. In such cases, unilateral TLIF would be better choice for those patients.

We found no significant differences of operation time, transfusion, postoperative stay, and patient's satisfaction (Table 1, Table 5).

Conclusion

The unilateral TLIF resulted in similar fusion rate and patients' satisfaction to the unilateral PLIF for the patients with the same spinal diseases. For the patients with severe spinal stenosis, PLIF offers more effective dural decompression than TLIF does. The unilateral PLIF, however, frequently needed massive facetectomy unless the interpedicular distance is long

enough. Therefore, we are emphasizing here that it is important for the surgeon to know the interpedicular distance for choosing the appropriate method before the surgery.

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