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Comparison of posterior lumbar interbody fusion with transforaminal lumbar interbody fusion for treatment of recurrent lumbar disc herniation: A retrospective study

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Abstract

Objective: To compare posterior lumbar interbody fusion (PLIF) with transforaminal lumbar interbody fusion (TLIF) for spinal fusion in patients previously treated by discectomy.

Methods: This retrospective study evaluated pre- and postoperative neurological status via Japan Orthopaedic Association (JOA) score. Surgical outcome was based on recovery rate percentage (RR%). Adverse event data were reviewed.

Results: Both PLIF ($n = 26$) and TLIF ($n = 25$) significantly improved neurological status. There were no significant between-group differences in postoperative JOA score, RR% or surgical outcome. Overall, 92.3% patients in the PLIF group and 84% in the TLIF group had an excellent or good outcome (RR $\geq$ 65%). No patient had a poor outcome (RR $<$ 50%). There were six cases of dural tear in the PLIF group and two in the TLIF group.

Conclusions: PLIF and TLIF provided good outcomes for recurrent lumbar disc herniation. TLIF may be preferred because of its shorter operative time and fewer procedure-related complications than PLIF.

Keywords

Lumbar disc herniation, spinal fusion, posterior lumbar interbody fusion, transforaminal lumbar interbody fusion, retrospective study

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Introduction

Discectomy, the surgical removal of herniated disc material, is one of the most common surgical procedures used for treating lumbar disc herniation. Although the surgical technique has been substantially improved, approximately 5–15% of patients experience recurrent lumbar disc herniation.[1–3] Surgical treatment for these problematic patients may be considered after a period of conservative treatment has failed to produce a satisfactory outcome.[3] Spinal fusion as the first reoperation following discectomy has become a common intervention and appears to reduce the risk of subsequent surgery.[4,5]

The popularity of the posterior lumbar interbody fusion (PLIF) procedure for spinal surgery has increased, with modifications such as autologous bone grafting, improved methods for spinal fusion, modern implants (including a variety of cages) and the use of pedicle screws for posterior instrumentation.[6] Another method for fusing the lumbar spine, the transforaminal lumbar interbody fusion (TLIF) procedure, has several advantages over PLIF, including preservation of the interspinous ligaments, minimal retraction of the dural sac and less neurological injury.[7]

To the best of our knowledge, there are few reports that have compared the surgical outcomes of PLIF and TLIF.[8–10] The purpose of this study was to compare the two surgical techniques as revision surgeries for lumbar disc herniation in patients previously treated by discectomy.

Patients and methods

Study population

We reviewed data from patients who had undergone reoperation following primary lumbar discectomy between January 2010 and May 2012. Inclusion criteria were: recurrent radicular pain after a pain free interval of at least 6 months; unilateral radicular pain refractory to conservative treatment for more than 6 weeks; recurrent disc herniation at the same level, regardless of whether it was on the ipsilateral or contralateral side. Exclusion criteria were: previous trauma; presence of tumours; rheumatoid arthritis. Diagnosis was confirmet via magnetic resonance imaging (MRI) in all cases. All herniations were at either L4/5 or L5/S1. The study was retrospective and required neither ethics committee approval at our hospital nor informed patient consent.

Surgical procedures

All procedures were performed by the same surgeon (Y.S.) with the patient under general anaesthesia and in the prone position on a radiolucent table. All patients had single level fusion performed. PLIF and TLIF were performed in the standard fashion,[3] and a single cage packed with an autologous bone graft was used in both procedures. Posterior pedicle screw instrumentation was used in all cases. Brace support was recommended for 8 weeks after surgery.

Outcome evaluation

Patients were assessed preoperatively and postoperatively at 1, 3, 6 and 12 months, then annually thereafter. Postoperative clinical and radiographic results and complications were reviewed by one investigator (Y.L.). Neurological status was assessed pre- and postoperatively using the modified Japan Orthopaedic Association (JOA) score for low back pain.[11] Scores were based on four categories: subjective symptoms (12 items, maximum score 9); clinical signs (9 items, maximum score 6); restriction of activities of daily living (7 items, maximum score 14); urinary bladder function (3 items, maximum score –6). Surgical outcome was expressed by recovery rate percentage (RR%) which was calculated from the

final follow up visit data using the equation: (postoperative JOA score – preoperative JOA score)/(29 – preoperative JOA score) $\times$ 100 (%). Outcome was defined as excellent (RR $\geq$ 80%), good (65% $\geq$ RR $<$ 80%), fair (65% $<$ RR $\geq$ 50%), or poor (RR $<$ 50%).[1,12] JOA scores and RR% were evaluated retrospectively by a single investigator (L.L.) to avoid interobserver variability. Bone fusion was confirmed by the formation of a trabecular bony bridge between contiguous vertebral bodies at the instrumented level seen by plain radiography at the final follow-up visit.[13]

Statistical analyses

Sample size estimation was calculated according to the inequality *t*-test for two means using PASS 2008 software (NCSS LLC, Kaysville, UT, USA). Assuming improvement rates for PLIF and TLIF procedures were 88 $\pm$ 5% and 80% $\pm$ 10%, respectively, and that alpha was 5% with a power of 80%, it was estimated that 17 patients were required in each treatment group.

Data were presented as mean $\pm$ SD and analysed using SPSS® version 12 (SPSS Inc, Chicago, IL, USA) for Windows®). Comparisons between pre- and postoperative data were made using paired *t*-tests, and between group comparisons were made using two sample *t*-tests. Qualitative data were analysed using χ^2 test, and Wilcoxon rank sum test was used for ranked data. *P*-values $<$ 0.05 were considered to statistically significant.

Results

Data were obtained from 51 patients (35 males/16 females, mean age 45 $\pm$ 6.8 years; age range 34–69 years), 26 of whom underwent PILF and 25 of whom underwent TLIF. There were no statistically significant between group differences in age, sex distribution, duration of pain, or location of surgery (Table 1). All patients were followed up for an average of 43 months (range 24–72 months) postoperatively.

Table 1. Characteristics of patients undergoing posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (TLIF) procedures for spinal fusion following primary lumbar discectomy.

Characteristic	PLIF group $n = 26$	TLIF group $n = 25$
Sex, males/females	17/9	18/7
Age, years	43.8 $\pm$ 12.1	44.5 $\pm$ 12.4
Duration of pain, years	4.8 $\pm$ 2.4	4.7 $\pm$ 2.7
Surgery location		
L4/5	11	9
L4/S5	15	16

Data presented as *n* or mean $\pm$ SD.
No statistically significant between group differences ($P \geq 0.05$; two sample *t*-test).

In both groups, postoperative JOA scores were significantly higher than preoperative scores (PLIF group: 16.1 $\pm$ 1.3 preoperatively vs 27.3 $\pm$ 0.7 postoperatively, $P < 0.05$; TLIF group: 15.0 $\pm$ 1.3 preoperatively vs 26.6 $\pm$ 1.7 postoperatively, $P < 0.05$). The RR% at the final follow up visit was 87.8 $\pm$ 4.5% in the PLIF group and 84.0 $\pm$ 10.1% in the TLIF group. There were no significant between group differences in postoperative JOA score or RR% (Figure 1). Overall, 24/26 (92.3%) patients in the PLIF group and 21/25 (84%) in the TLIF group had an excellent or good outcome (RR $\geq$ 65%), and no patient had a poor outcome (RR $<$ 50%).

There were six cases of a dural tear in the PLIF group and two cases in the TLIF group, all of which were repaired intraoperatively. Postoperative cerebrospinal fluid leakage occurred in three cases in the PLIF group; this ceased within 5 days without clinical sequelae. A single patient in the PLIF group had a transient neurological deficit that was completely resolved at

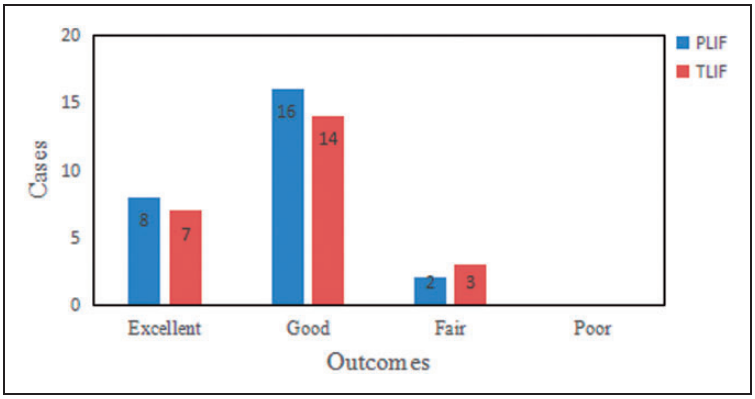

Figure 1. Surgical outcomes of posterior lumbar interbody fusion (PLIF; $n = 26$) or transforaminal lumbar interbody fusion (TLIF; $n = 25$). Data are based on recovery rate percentage (RR%) calculated at final follow up visit: RR% = (postoperative Japan Orthopaedic Association [JOA] score – preoperative JOA score)/(29 – preoperative JOA score) × 100.[1,12] Excellent, RR ≥ 80%; good, 65% ≥ RR < 80%; fair, 65% < RR ≥ 50%; poor, (RR < 50%). No statistically significant between group differences ($P \geq 0.05$; *t*-test).

3 month follow-up. No cases of nonunion, reherniation, or other complications were observed at final follow-up in any patient.

Discussion

Recurrent herniation rates after lumbar discectomy vary widely partly because of differences in the definition of reherniation.[2] In the current study, reherniation was defined as disc herniation at the same level as the primary herniation, regardless of whether it was ipsilateral or contralateral, with a pain-free interval of at least 6 months. For the purpose of treatment comparisons, only patients who experienced unilateral radicular pain were included.

Not only is the aetiology of recurrent lumbar disc herniation uncertain, but there is no consensus on management. In one study, only 8% of patients complaining of recurrent back and/or leg pain responded well to nonsurgical treatment (i.e., rest, nonsteroidal anti-inflammatory drugs, physical therapy and/or epidural injection).[14] In other studies, surgery was used following a period of conservative treatment but the optimal surgical approach for recurrent disc herniation remains unclear;[13] it may include interbody fusion after adequate decompression (which is thought to eliminate segmental motion), immobilization of the spine, reduction of mechanical stress across the degenerated disc space, and excavation of the damaged disc and repair of the vertebral endplates.[2,3] In the current study, PLIF and TLIF procedures were performed using pedicle screw instrumentation to augment the fusion.[15] At the final follow-up, all patients had attained solid interbody fusion and there was no obvious evidence of pseudarthrosis or recurrence of disc herniation.

To our knowledge, few reports have compared the surgical outcomes of PLIF and TLIF. A study of 50 patients with recurrent lumbar disc herniation who were monitored for an average period of 2 years after PLIF found that 92% reported symptom alleviation and 95% had radiographic evidence of solid fusion.[16] Another study of 43 patients with recurrent lumbar disc herniation who were monitored for an average of 45 months after TLIF showed that all patients experienced significant relief of their radicular pain within 1 month

postoperatively, clinical outcome was excellent/good in 86.1% of patients and fair in 13.9% patients, and fusion was achieved in all patients at 2 years postoperatively.[5] In the current study, all patients in both groups achieved statistically significant improvements in neurological status. Furthermore, 92.3% patients in the PLIF group and 84% in the TLIF group had an excellent or good outcome, and no patient had a poor outcome. There was no significant difference in RR% between the two surgical groups. Our present findings are similar to those of others where PLIF and TLIF were compared as the primary surgical procedures for lumbar degenerative diseases.[8–10]

The use of PLIF has been associated with a higher risk of neural complications than TLIF.[17–19] A single patient in the PLIF group in the present study experienced transient neurological deficit, probably due to the need for substantial medial retraction of the thecal sac during their procedure. TLIF avoids these injuries because the disc space is approached via the far lateral portion of the vertebral foramen, reducing thecal manipulation.[9] Dural tear is probably the most common complication of reoperation,[3,7] and occurred more commonly in the PLIF group than the TLIF group in the present study. This may have been due to scar adhesion to the dura in PLIF. All repairs were performed intraoperatively, and would have led to an increase in operative time. Therefore, we postulate that TLIF may be preferred by patients and surgeons because of its potentially shorter operative time and fewer procedure-related complications than PLIF.

The limitations of this study include its retrospective design, small sample size and brief follow-up period. Further prospective, long term studies involving a large sample size are required to confirm our findings.

In conclusion, this review of retrospective data from a small group of patients showed that both PLIF and TLIF provide excellent/good outcomes as treatment of recurrent lumbar disc herniation. However, in our clinical practice, TLIF is preferred over PLIF because of its potentially shorter operative time and fewer complications.

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Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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