

Comparison of simple discectomy and uninstrumented lumbar interbody fusion in patients with lumbar disc herniation

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Abstract

Aim: This study aimed to compare the surgical outcomes of simple discectomy (SD) and uninstrumented posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (TLIF) in patients with lumbar disc herniation (LDH).

Materials and Methods: The files of randomly selected 100 patients with LDH, who underwent SD, were analyzed. The patients were divided into two groups as Group 1 involving 50 patients undergoing SD alone and Group 2 involving 50 patients undergoing SD plus unilateral PLIF and TLIF without posterior lumbar instrumentation. The pain was measured by the visual analog scale (VAS) and the functionality of the patients was measured by the Oswestry disability index (ODI).

Results: In both groups, leg and low back pain VAS scores and ODI scores improved significantly one year after surgery ($p < 0.001$). There was a significant increase in the VAS scores of Group 2 in the first month compared to Group 1 ($p < 0.001$), but there was no significant difference in the first year ($p > 0.05$).

Conclusion: This study has shown that PLIF and TLIF performed following unilateral SD without posterior lumbar instrumentation support in single-distance LDH treatment will not be sufficient.

Keywords: Back pain; discectomy; interbody fusion; lumbar disc herniation

INTRODUCTION

Low back pain is a very common complaint in the community. About 60-80% of people experience low back pain at least once in their lifetime and 35% experience sciatica pain. Surgical intervention may be required for 10% of individuals with lumbar disc herniation (LDH). For this reason, low back pain and LDH cause a great problem in society. Surgical treatment has been reported to be more beneficial than conservative treatment in patients with severe symptoms. Classical simple discectomy (SD) technique was first described by Mixter and Barr in 1934 (1). Although SD is associated with successful clinical outcomes in the early period, the success rate in long-term follow-up decreases to 40-80% in terms of residual low back pain and recurrent LDH. Combination of interbody fusion with SD is recommended to avoid residual low back pain and recurrent LDH. The necessity and efficacy of fusion after SD in patients with single-distance LDH is still controversial (2). It can be performed as fusion, interbody fusion, and posterior or posterolateral fusion in the lumbar spine. Interbody fusion is more effective and safer than

posterolateral fusion. The interbody cage or similar tools stabilize the spine immediately, restore the disc space height, provide normal sagittal spinal alignment, provide distraction between segments, prevent the disc space from collapsing, and increase the fusion rate. Interbody fusion techniques include anterior lumbar interbody fusion (ALIF), axial lumbar interbody fusion (AxiaLIF), posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF) (3). Intervertebral body fusion was first defined by Cloward for LDH (4).

The PLIF and TLIF procedures have been described as a reliable posterior-centered interbody fusion procedure that can provide nerve root decompression and disc space height reconstruction used in various spine surgeries in the literature (5,6).

This study aimed to retrospectively compare the clinical outcomes of SD with those of PLIF or TLIF application without posterior lumbar instrumentation after SD in patients with unilateral and single distance LDH, who had no radiological and clinical spinal instability.

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MATERIALS and METHODS

Patient selection

This study included a total of 100 patients operated in Corlu Reyap Hospital neurosurgery clinic for LDH between January 2017 and December 2018. The electronic files and radiological images of the patients were analyzed retrospectively. The surgical technique to be applied was explained in detail before the operation and the informed consent of the patients was obtained. Group 1 included 50 patients undergoing SD. Group 2 included 50 patients undergoing unilateral PLIF or TLIF without posterior lumbar instrumentation after SD. Of these patients, 35 underwent PLIF and 15 underwent TLIF.

Inclusion and exclusion criteria

The inclusion criteria were as follows: having unilateral and single-distance LDH on magnetic resonance imaging (MRI), not responding to conservative treatment for at least six weeks, having lower back and unilateral leg pain, and undergoing SD or SD plus PLIF or TLIF. Patient selections were randomly made in a way that the number of patients in the two groups would be equal.

Patients with a preoperative spinal fracture, spinal tumor, spondylolisthesis, severe scoliosis (Cobb angle of 40 degrees or above), spine or disc infection, and recurrent LDH were excluded from the study.

Surgical procedure

All operations were performed by a single neurosurgeon under a microscope at a single center. Before the operation, a single dose of prophylactic antibiotics (1 g cefazolin) was administered intravenously to all patients. All patients were operated under general anesthesia in the prone position. The technique used in 50 patients in Group 1 was SD. The distance to be operated was determined via C-arm fluoroscopy. After the skin was properly cleaned and a drape sheet was placed, a 1.5–3 cm incision was made on the lower back. The paravertebral muscles were dissected unilaterally. As a classical approach, hemilaminectomy, excision of ligamentum flavum, SD, and foraminotomy were performed. Nerve root was released. After hemostasis control was achieved, the layers were closed in accordance with their anatomy.

In patients in Group 2, an aggressive discectomy was performed following unilateral facetectomy in addition to the procedure performed in Group 1. Endplates were cleaned on the symptomatic side in the PLIF/TLIF group. Appropriately sized autograft or allograft bone grafts and intervertebral cages were placed in the disc space under C-arm fluoroscopy (Figure 1).

Outcome measures

Age, gender, level of surgery, operative time, and length of hospital stay were recorded for each patient. Whether the surgical intervention was required to be repeated during the one-year follow-up period was investigated. Patients were evaluated clinically before the surgery and on the

10th day, first month and first year postoperatively. Visual analog scale (VAS) score was used both before and after surgery to evaluate the severity of pain. According to the VAS pain score, patients were asked to rate their pain from 0 to 10 (0 represents the lowest score without pain and 10 represents the highest score with the worst pain ever experienced). Oswestry Disability Index (ODI) scale was used to evaluate the functional status of the patients. The ODI is a questionnaire consisting of 10 domains evaluating the intensity of pain, lifting, ability to care for oneself, ability to walk, ability to sit, sexual function, ability to stand, social life, sleep quality, and ability to travel.

Each question is scored on a scale of 0 to 5; 0 represents the least amount of disability and 5 represents severe disability. The scores of all the questions were summed up and then multiplied by two to obtain the ODI score (range 0-100). A total score of 0 indicated no disability and 100 indicated maximum disability possible. The pre- and postoperative (10th day, first month, and first year) VAS scores and the pre-operative and first postoperative year ODI scores of the patients were evaluated.

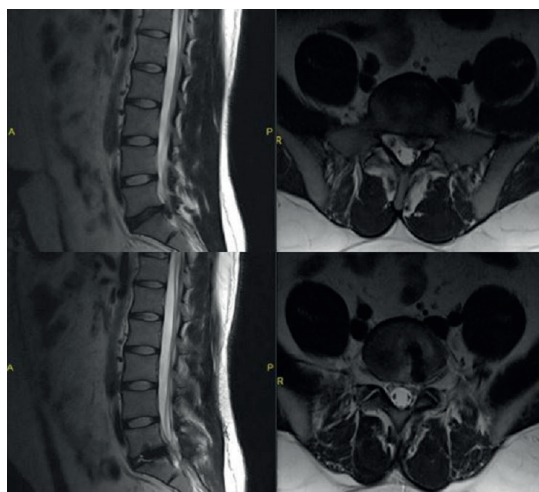


Figure 1. Preoperative sagittal and axial lumbar MRI images (upper figures) and early postoperative sagittal and axial lumbar MRI images (lower figures) of a 32-year-old male patient

Statistical analysis

Pre- and postoperative low back pain VAS, leg pain VAS, and ODI scores were examined and the changes observed in these scores according to groups were investigated. Categorical data were expressed as frequencies and percentages while quantitative as Mean \pm S.D. The groups were compared by chi-square test according to gender, operated disc level, operative time and length of hospital stay. The age variable comparison between the two groups was made with the independent sample t test. Statistical and visual analyzes were utilized in the analysis of the data. Two-factor repeated measures analysis of variance (ANOVA) was used to analyze the changes in VAS and ODI scores over time. Statistical analysis was performed using SPSS version 22.0 software. A p value of <0.05 was considered statistically significant.

RESULTS

Patients' Characteristics

The demographic characteristics of the patients in Group 1 and Group 2 are shown in Table 1. There was no statistically significant difference between the groups in terms of age, gender and LDH level ($p>0.05$).

The mean age was 49.08 ± 13.09 years (25-80 years) and 47.68 ± 11.93 years (28-73 years) in Group 1 and Group 2, respectively. There were 25 male and 25 female patients in Group 1, 22 male and 28 female patients in Group 2.

In the SD group, seven patients had L3-4 disc herniation, 27 patients had L4-5 disc herniation, and the remaining 16

patients had L5-S1 disc herniation. In the PLIF/TLIF group, seven patients had L3-4 disc herniation, 27 patients had L4-5 disc herniation, and the remaining 18 patients had L5-S1 disc herniation.

The mean operative time was 53.60 ± 7.69 minutes (40-70 minutes) and 63.10 ± 8.19 minutes (45-90 minutes) in Group 1 and Group 2, respectively. The mean length of hospital stay was 2.54 ± 0.70 days (2-5 days) and 3.74 ± 1.12 days (3-10 days) in Group 1 and Group 2, respectively. There was a statistically significant difference between the two groups in terms of mean operative time and mean hospital stay ($p<0.001$). These values were longer in Group 2.

Table 1. Demographic data of the patients and levels operated on

	Group 1	Group 2	p-values
Total number of patients (n)	50	50	0.548
Number of male patients	25 (50%)	22 (44%)	
Number of female patients	25 (50%)	28 (56%)	
Mean age of the study population (years)	49.08 ± 13.09 (25-80)	47.68 ± 11.93 (28-73)	0.578
Levels operated on (%)			
L3-4	7 (14%)	5 (10%)	0.940
L4-5	27 (54%)	27 (54%)	
L5-S1	16 (32%)	18 (36%)	
Operative time (min)			
0-59 min	32(64%)	4(8%)	<0.001
60 min	12 (24%)	30(60%)	
>60 min	6 (12%)	16(32%)	
Length of hospital stay (days)			
2 days	28(56%)	0(0%)	<0.001
3 days	18(36%)	24(48%)	
4 and more days	4(8%)	26(52%)	

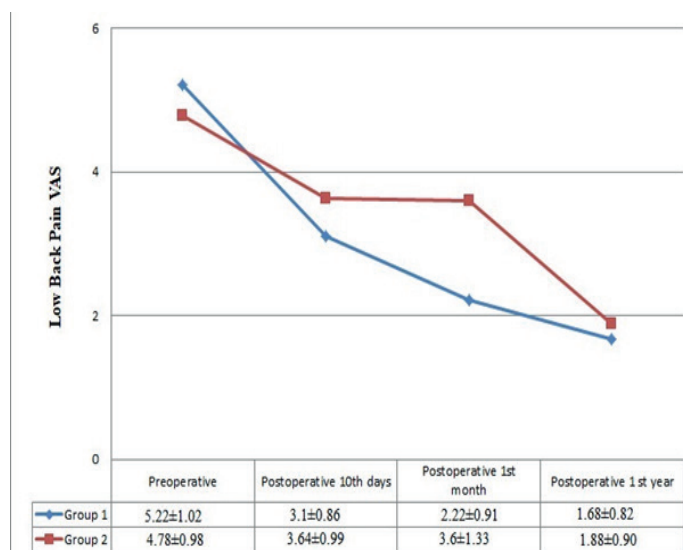


Figure 2. Mean preoperative and postoperative low back pain VAS scores by groups.

Postoperative health status analysis

Figure 2 shows a visual analysis of the changes in low back pain VAS scores by groups. The graph shows that there is a continuous decrease in the values of Group 1 over time whereas the values of Group 2 decrease in general. However, low back pain VAS values remained approximately the same from the 10th postoperative day to first postoperative month.

Table 2 shows the findings of variance analysis of the changes observed in the low back pain VAS values before and after the intervention according to the groups. Intergroup comparisons were examined with Bonferroni corrections to determine which measurements the difference was between.

Low back pain VAS scores of Group 1 were found to be significantly lower in the first-month measurements. There wasn't a significant difference between the groups in terms of the first postoperative year measurements.

Table 2. Results of the variance analysis of the changes observed in the pre-test and post-test results of low back pain VAS values by groups

	Sum of squares	df	Mean Square	F	p	Partial Eta Squared
Time	535.250	3	178.417	321.511	<0.001	0.77
Group	4.410	1	17.640	7.975	0.006	0.08
Time * Group	43.100	3	14.367	25.889	<0.001	0.21
Error	163.150	294	0.555			

These findings indicated that there was a faster decrease in Low Back Pain VAS scores in Group 1 and that patients in this group showed much faster improvement particularly between postoperative day 10 and first postoperative month; however, the Low Back Pain VAS scores of the groups reached about the same level at the end of the first postoperative year.

Figure 3 shows a visual analysis of the changes in leg pain VAS scores by groups. It can be seen from the graph that there was a significant decrease in Leg Pain VAS values on the 10th postoperative day in both groups and that this decrease stabilized in subsequent measurements and Leg Pain VAS values became approximately stable.

Table 3 shows the findings of variance analysis of the changes observed in the leg pain VAS values before and after the intervention according to the groups. Intergroup comparisons were examined with Bonferroni corrections to determine which measurements the difference was between. Leg Pain VAS values decreased continuously until the first postoperative month while the values stabilized after the first month in both groups.

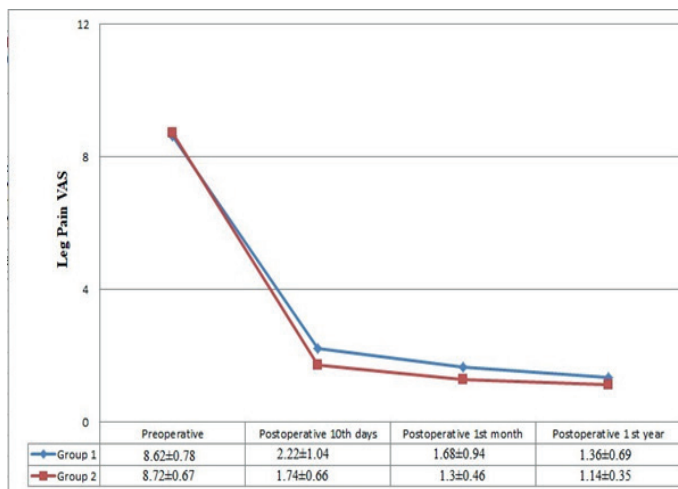


Figure 3. Mean preoperative and postoperative leg pain VAS scores by groups

There was no significant difference between the groups in terms of the first postoperative month and first postoperative year measurements.

Table 3. Results of the variance analysis of the changes observed in the pre-test and post-test results of leg pain VAS values by groups

	Sum of squares	df	Mean Square	F	p	Partial Eta Squared
Time	3804.887	3	1268.296	3241.439	<0.001	0.97
Group	6.002	1	6.002	6.262	0.014	0.06
Time * Group	4.828	3	1.609	4.113	0.007	0.04
Error	115.035	294	0.391			

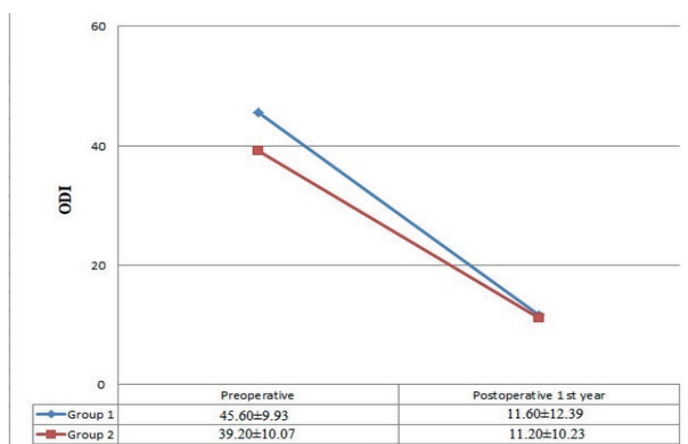


Figure 4. Mean preoperative and postoperative ODI scores by groups

Figure 4 shows a visual analysis of the changes in ODI scores by groups. The graph showed that there was a significant decrease in ODI values in the first postoperative year in both groups.

Table 4 shows the findings of variance analysis of the changes observed in the ODI values before and after the intervention according to the groups. Intergroup comparisons were examined with Bonferroni corrections to determine which measurements the difference was between. There was a decrease in the postoperative ODI values in both groups. While the preoperative ODI values in Group 1 were higher than Group 2, the ODI values of both groups reached approximately the same level one year after the operation.

Table 4. Results of the variance analysis of the changes observed in the pre-test and post-test results of ODI values by groups

	Sum of squares	df	Mean Square	F	p	Partial Eta Squared
Time	48050.000	1	48050.000	493.079	<0.001	0.83
Group	578.000	1	578.000	4.391	0.039	0.04
Time * Group	450.000	1	450.000	4.618	0.034	0.05
Error	9550.000	98	97.449			

Complications

No severe complications and neurological damage were observed in both groups during the operation and in the early postoperative period. There were no recurrence, instability, and surgical site infection in the long term in both groups. Posterior lumbar instrumentation was performed as the second surgical procedure for only one patient with severe low back pain and an MRI showing Modic type 1 change in Group 2 (Figure 5).

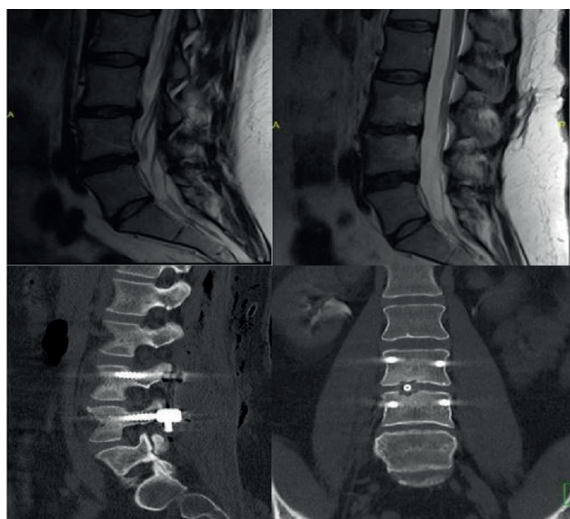


Figure 5. Preoperative and postoperative 4th month sagittal lumbar MRI images and Modic type changes (upper figures) and postoperative 1st month after posterior lumbar instrumentation sagittal and coronal lumbar computed tomography (CT) images (lower figures) of a 39-year-old female

DISCUSSION

No segmental instability has been reported following unilateral facetectomy without instrumentation. In another study, a single-segment bilateral PLIF has been reported to require pedicle screw fixation. The number of studies comparing unilateral single segment PLIF with SD is limited. An article published in 2017 has emphasized that PLIF is superior to SD (2,7,8). The results of the present study have shown no significant difference between these two methods at the end of the first postoperative year. In addition, there was a significant increase in low back pain VAS scores in the first postoperative month in group 2.

In a prospective study (2013) involving patients with single-distance lumbar degenerative disc disease and no preoperative instability, patients undergoing TLIF

with and without pedicle screw were compared. In this study, treatment was found to be sufficient in patients with lumbar degenerative spine disease requiring fusion following single-level decompression and undergoing TLIF without pedicle screw fixation, which has been reported to increase the cost and complications (9). In the present study, 30% of the intervertebral cages are TLIF.

In a recent study, large TLIF sizes have been asserted to cause nerve root stretch and undesired neurological deficits in patients with LDH and lumbar spinal stenosis. Therefore, compression of the intervertebral space following the placement of pedicle screws and a TLIF of a smaller size, respectively, has been reported to cause fewer complications (10). Minimally invasive TLIF performed using transpedicular screws has been reported to be more advantageous than the classical open TLIF procedure (11). In a series of patients undergoing PLIF with autograft iliac crest bone grafting published after an about 30-year follow-up in 2018, clinical outcomes have been found to be excellent or good (87%). In the same series, the total complication rate has been reported to be 7% (12). Percutaneous endoscopic lumbar discectomy (PELD) and minimally invasive TLIF were compared in another study conducted in 2019. This study has shown that positive clinical results have been achieved via both methods, but the complication rates are different. Success and satisfaction rates in PELD have been found to be lower whereas the probability of postoperative chronic low back pain and recurrence has been higher (13). In the present study, no recurrence developed during the one-year follow-up in both groups and pedicle screw fixation was needed only in one patient, who underwent PLIF, due to low back pain.

In the literature, there are also studies comparing the titanium and polyethylene ether ketone (PEEK) cages in the treatment of lumbar degenerative disc diseases. In a study published in 2017, no significant difference was found between the two cages in the long term (14).

In the surgical treatment of patients with recurrent LDH, TLIF performed with bilateral pedicle screw has been reported as a safe and effective procedure (15).

Another study has reported that minimally invasive TLIF is more advantageous than traditional open techniques. In this study, TLIF was supported with bilateral percutaneous pedicle screw-rod. Therefore, the mean operative time and length of hospital stay were found to be 240 minutes and 1.9 days, respectively (16). In a study very similar to the present manuscript, the mean operative time has

been found to be 56 minutes and 86 minutes in the SD group and PLIF group, respectively. In the same study, the mean length of hospital stay was two days in the SD group and two and a half days in the PLIF group (2). The results obtained from the present series are also compatible with this study. As a matter of course, operative time was longer in the group where PLIF or TLIF is performed after SD.

In a study published in 2019, minimally invasive TLIF results were successfully mentioned in various lumbar degenerative disc diseases (17). However, depending on this method, it is stated that radiculopathy can develop on the opposite side (18). In addition, there was no significant difference in fusion rates between titanium and peek cages in TLIF (19). In this method, scar tissue develops less because muscle and soft tissue injuries are less (20). In a recent meta-analysis, PLIF and TLIF were compared and no statistically significant difference was found between clinical results (21).

The number of studies comparing clinical results of SD procedure and SD plus uninstrumented PLIF/TLIF application in patients with LDH is very limited. The number of patients in our study was slightly higher compared to several similar studies reported in the literature. Although results and complication rates are similar to previous studies, we have also achieved different results.

CONCLUSION

We believe that it is unnecessary to perform uninstrumented PLIF/TLIF in addition to SD for single-distance LDH since the patient experience more low back pain in the medium term after surgery, cost increases because of the materials used, pedicle screw fixation may be needed in the long term, and operative time and length of hospital stay is longer. Therefore, we believe that SD is more advantageous. However, there is a need for further studies with longer follow-up periods and a larger number of patient groups to obtain more reliable results.

Conflict of interest: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: Permission from Chief Physician to use data (Approval Number: 27.04.2020/960)

REFERENCES

- Ozger O, Kaplan N. Evaluation of clinical outcomes of 271 patients undergoing lumbar microdiscectomy in the light of literature. *Annals Med Res* 2020;27:664-9.
- Kale A, Oz II, Onk A, et al. Unilaterally posterior lumbar interbody fusion with double expandable peek cages without pedicle screw support for lumbar disc herniation. *Neurol Neurochir Pol* 2017;51:53-9.
- Koc RK, Tucer B. Percutaneous Axial Lumbar Interbody Fusion (AxiaLIF). *Türk Nöroşirürji Dergisi* 2009;19:231-236.
- Cloward RB. The treatment ruptured intervertebral disc by vertebral body fusion. *J Neurosurg* 1953;10:154-68.
- Cheng X, Zhang F, Zhang K, et al. Effect of Single-Level Transforaminal Lumbar Interbody Fusion on Segmental and Overall Lumbar Lordosis in Patients with Lumbar Degenerative Disease. *World Neurosurg* 2018;109:244-51.
- Yilmaz T, Dalbayrak S, Yaman O, et al. A modified technique for the treatment of isthmic spondylolisthesis. *Turk Neurosurg* 2015;25:394-403.
- Bhatia NN, Lee KH, Bui CN, et al. Biomechanical evaluation of an expandable cage in single-segment posterior lumbar interbody fusion. *Spine (Phila Pa 1976)* 2012;37:79-85.
- Tender GC, Baratta RV, Voorhies RM. Unilateral removal of pars interarticularis. *J Neurosurg Spine* 2005;2:279-88.
- Kotil K, Ali Akcetin M, Savas Y. Clinical and radiologic outcomes of TLIF applications with or without pedicle screw: a double center prospective pilot comparative study. *J Spinal Disord Tech* 2013;26:359-66.
- Sun K, Sun X, Huan L, et al. A modified procedure of single-level transforaminal lumbar interbody fusion reduces immediate post-operative symptoms: a prospective case-controlled study based on two hundred and four cases. *Int Orthop* 2020;44:935-45.
- Zhao H, Gao H, Zhou C, et al. A randomized controlled trial with ≥ 5 years of follow-up comparing minimally invasive and open transforaminal lumbar interbody fusion in disc herniation at single level. *Exp Ther Med* 2019;17:3614-20.
- Prolo LM, Oklund SA, Zawadzki N, et al. Uninstrumented Posterior Lumbar Interbody Fusion: Have Technological Advances in Stabilizing the Lumbar Spine Truly Improved Outcomes? *World Neurosurg* 2018;115:490-502.
- Liu C, Zhou Y. Percutaneous endoscopic lumbar discectomy and minimally invasive transforaminal lumbar interbody fusion for massive lumbar disc herniation. *Clin Neurol Neurosurg* 2019;176:19-24.
- Mittal P, Kumar A, Baria R. Outcomes of kidney vs PEEK cages used in transforaminal lumbar interbody fusion (TLIF) for the treatment of degenerative lumbar spine. *Int J Ortho Sci* 2017;3:626-9.
- Omidi-Kashani F, Ghayem Hasankhani E, Noroozi HR. Instrumented transforaminal lumbar interbody fusion in surgical treatment of recurrent disc herniation. *Med J Islam Repub Iran* 2014;28:124.
- Schwender JD, Holly LT, Rouben DP, et al. Minimally invasive transforaminal lumbar interbody fusion (TLIF): technical feasibility and initial results. *J Spinal Disord Tech* 2005;18:1-6.
- Sayari AJ, Patel DV, Yoo JS, et al. Device solutions for a challenging spine surgery: minimally invasive transforaminal lumbar interbody fusion (MIS TLIF). *Expert Rev Med Devices* 2019;16:299-305.

18. Yang Y, Liu ZY, Zhang LM, et al. Risk factor of contralateral radiculopathy following microendoscopy-assisted minimally invasive transforaminal lumbar interbody fusion. *Eur Spine J* 2018;27:1925-32.
19. Cacan MA, Ucar BY. What every spine surgeon should know about transforaminal lumbar interbody fusion surgery for herniated discs. *International Orthopaedics (SICOT)* 2019;43:883-9.
20. Zhang S, Chen H, Ge D, et al. Mini-open transforaminal lumbar interbody fusion through a modified Wiltse paraspinal approach for recurrent lumbar disc herniation. *Int J Clin Exp Med* 2019;12:2525-31.
21. Lan T, Hu SY, Zhang YT, et al. Comparison Between Posterior Lumbar Interbody Fusion and Transforaminal Lumbar Interbody Fusion for the Treatment of Lumbar Degenerative Diseases: A Systematic Review and Meta-Analysis. *World Neurosurg* 2018;112:86-93.