

Anterior Lumbar Interbody Fusion in Patients With a Previous Discectomy

Minimum 2-Year Follow-Up

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Objective: A retrospective review was conducted to determine the availability of anterior lumbar interbody fusion (ALIF) in selected patients who presented with recurrent lumbar disc herniation.

Methods: A total of 22 patients who underwent ALIF were studied clinically and radiographically. The patients were 11 men and 11 women, with a mean age of 46 years (range 23–60 years) at the time of ALIF. The mean follow-up duration was 35 months (range 30–42 months). The fused level at which the ALIF was performed was as follows: L3–L4 (1 patient), L4–L5 (14 patients), and L5–S1 (7 patients). Back pain, leg pain, and functional outcomes were measured both before surgery and at the last follow-up visit. Patient satisfaction index was also assessed.

Results: Leg pain, back pain, and functional status all demonstrated statistically significant improvements between preoperative and postoperative scores by 86%, 77%, and 82%, respectively ($P < 0.001$). Nineteen of 22 patients (86.3%) were satisfied with their clinical results. Solid fusion was found in all patients.

Conclusions: The authors found ALIF to be an effective procedure with satisfactory clinical results in selected patients with a recurrent disc herniation in the lumbar spine.

Key Words: anterior lumbar interbody fusion, recurrent lumbar disc herniation

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Recurrent herniation after conventional open lumbar discectomy has been reported in 5–11% of patients.^{1–3} Primary discectomy gives good surgical results, but for revision surgery, positive results are less certain and the risks are greater. Surgical treatment of recurrent lumbar disc herniation has not been fully standardized, even though some authors have reported that repeat discectomy is the preferred management technique of recurrent lumbar disc herniation.^{3–6}

Since the first description of the anterior lumbar interbody fusion (ALIF) application to lumbar disc disease in 1933,⁷ numerous surgeons have advanced the surgical technique toward minimizing iatrogenic trauma. As a result, the ALIF procedure has evolved into an effective treatment option in patients with lumbar degenerative disorders, including degenerative disc disease, grade I spondylolisthesis, and symptomatic pseudoarthrosis. Recent advances in minimal invasive techniques have generated a great deal of interest in the ALIF procedure, and now spine surgeons consider it as being less invasive than posterior fusion techniques.⁸

Many studies regarding the clinical outcome after treatment of recurrent lumbar disc herniation have been reported. However, the majority of data in the literature has dealt with the posterior approach with or without fusion of the affected segment. Thus, there have been few published articles describing the clinical outcome after ALIF for recurrent lumbar disc herniation. In the current study, we report our experience with 22 patients who underwent ALIF to treat recurrent lumbar disc herniation in our hospital.

METHODS

Patient Population

Twenty-two patients in our hospital underwent a mini-open laparotomy followed by the ALIF procedure to treat recurrent lumbar disc herniation between July 2000 and September 2001. The patients were 11 men and 11 women, with a mean age of 46 years (range 23–60 years). The mean follow-up duration was 35 months (range 30–42 months). All patients had undergone previous surgery with conventional open discectomy. Recurrent lumbar disc herniation was defined as ipsilateral disc herniation at the same level, with a pain-free interval of >6 months. In all cases, the inclusion criterion for surgery was intractable radicular pain combined with back pain of >8 weeks' duration refractory to conservative treatment. In all patients, a trial of prolonged multimodal conservative management, consisting mainly of stretching and strengthening exercises and a course of analgesic and muscle relaxant agents, had failed. The clinical characteristics of the 22 patients are presented in Table 1.

Surgical Technique

We modified the mini-open laparotomy, which was originally reported by Onimus et al,⁹ with the use of an anterior

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TABLE 1. Summary of Clinical Characteristics of 22 Patients

Sex ratio (M/F)	11:11
Mean age \pm SD (y)	45.7 \pm 10.5 (23–60)
Mean follow-up duration \pm SD (mo)	35.0 \pm 8.9 (30–42)
Involved level	
L3–L4	1
L4–L5	14
L5–S1	7

retroperitoneal approach and employed it as a standard approach to the anterior lumbar spine.

With the patient supine, a standard paramedian vertical 4-cm incision was made 1 cm below the umbilicus for L4–L5, at the umbilicus for the L3–L4, and halfway between the umbilicus and the symphysis pubis for the L5–S1 approach. In women, a cosmetic horizontal suprapubic incision was possible for the L5–S1 approach. The subcutaneous tissues were divided using electrocautery to expose the anterior rectus sheath. The sheath was then divided longitudinally along the direction of its fibers, and the epigastric vessels were divided as needed. The rectus muscle was retracted laterally, and the posterior rectus sheath was divided with the transversalis fascia at the lateral edge of the rectus. This division began at the arcuate line. The peritoneum and its contents were retracted medially by blunt dissection to expose the iliopsoas muscle and the lumbar spine. The significant landmark was the prominence of the psoas muscle at this point. The ureter was adherent to and swept medially along the peritoneum, which was retracted medially. A Robotrac self-retaining retractor (Aesculap, Tuttlingen, Germany) was then placed to keep the abdominal contents rostrally retracted. The left common iliac artery and vein were identified and traced to their bifurcation. For exposure of L4–L5, the distal aorta, inferior vena cava, and iliac vessels were mobilized to the right after dissecting them from the anterior aspect of the disc space with a sponge stick, thus exposing the vertebral body and disc space. The iliolumbar vein was eventually divided and ligated with a hemoclip to allow caudal retraction of the left iliac vein. For exposure of L5–S1, the middle sacral vessels were hemoclipped and divided. During the procedure, hand-held retractors were used to retract vascular structures, and pressure on the vessels was released at periodic intervals. Electrocautery was avoided during the dissection of the prevertebral soft tissue.

Once the anterior surface of the spine was exposed and the causative lesion was confirmed, the anterior longitudinal ligament was divided transversely and the discectomy carried out. The disc was removed with the use of pituitary forceps, down-biting curettes, and long-shafted ring curettes. The discectomy was extended deeply enough so that all disc material could be removed from the disc space at the involved level. Intervertebral distraction using an interspace distracter plug facilitated resection of disc material and allowed cage insertion. Appropriate care was taken to resect as little of the cancellous bone as possible to minimize the risk of subsidence. The cleaned intervertebral space was visually inspected, and the depth of the intervertebral disc space was measured with a graduated disc shaver. Any remnant disc material was

removed until identification of the posterior longitudinal ligament was possible, so that anterior canal decompression could be achieved. However, we did not violate the posterior longitudinal ligament during the procedure.

We used paired rectangular cages, which enable easy insertion. The cage chambers were filled with allograft bone chips (Regeneration Technology, Alachua, FL). Two kinds of cages were used in our series (Lumbar I/F cage [DePuy Acromed, Raynham, MA] and Fidji cage [Spine Next, Bordeaux, France]). Upon completion of the cage insertion, complete hemostasis was performed. The anterior rectus sheath was reapproximated, and then the subcutaneous and skin layers were closed layer by layer. Two days after the operation, all the patients were allowed to ambulate with a lumbar orthosis, which was usually worn for 2 months.

Outcome Assessment

Postoperatively, patients were followed up on an outpatient basis. Clinical outcome was retrospectively evaluated by the criteria proposed by Yuan et al.¹⁰ Each patient completed a survey that measured pain (back and leg pain separately) and functional outcomes. This evaluation was performed before surgery and at the last follow-up visit. Details of the assessment form are outlined in Tables 2 and 3.

In brief, pain was measured on a 5-point scale, with a score of 1 corresponding to no residual pain and a score of 5 corresponding to severe pain with serious limitations of activity, often requiring chronic medication use. Independent pain measurements were made for leg and back symptoms. Functional outcomes were also measured on a 5-point scale, with a score of 1 corresponding to independence with respect to mobilization and activities of daily living and a score of 5 corresponding to extreme limitations in walking or the need for major assistance with daily life activities. Patient satisfaction index (PSI)¹¹ was also assessed using the following question: “Would you have the same treatment again for the same outcome?” The response was graded as 1 (definitely not), 2 (probably not), 3 (not sure), 4 (probably yes), and 5 (definitely yes). Patients who selected categories 4 or 5 were regarded as satisfied with their outcome. We recorded information regarding the mean time interval between the previous discectomy and ALIF, operative time, blood loss, length of hospital stay, and surgery-related complications from hospital and office records. The operative time was divided into preparation and procedure time. Preparation time was the interval

TABLE 2. Pain Definitions

Score	Definition
1	None: no pain or patient ignores pain
2	Slight: occasional pain, no compromise in activities
3	Mild: no effects on ordinary activities, rarely moderate pain with unusual activities, may take aspirin
4	Moderate: pain tolerable, but patient makes concessions to pain, some limitations of ordinary activities or work, may require occasional medication other than aspirin
5	Severe: pain sufficient to cause serious limitations activities, chronic or frequent prescription pain medications

TABLE 3. Functional Definitions

Score	Definition
1	Functions at previous level without restriction; independent in leisure activities and activities of daily living; walks unlimited distances; independent in wheelchair activity (transfer, sports, driving, self-catheterization) with paraplegia
2	Mild limitations of function, with some restrictions; mildly limited in leisure activities and activities of daily living; walks five to six blocks; dependent in some aspects of wheelchair activities (sports, driving) with paraplegia
3	Moderate limitations of function but employable; moderately limited in leisure activities and activities of daily living; walks three to four blocks; moderately dependent in wheelchair activity with paraplegia
4	Severe limitations of function, unemployable; severely limited in leisure activities and activities of daily living; walks one to two blocks; severely dependent in wheelchair activity with paraplegia
5	Invalid or bedridden because of spine; walks less than one block

from anesthesia induction to initial incision. Postoperative radiographs, including dynamic flexion–extension views, were obtained at regular intervals to assess fusion progression. In some cases, postoperative computed tomography (CT) and magnetic resonance imaging (MRI) were obtained to supplement the radiographic findings. A fusion was confirmed by a progressive increase in interspace bone density and blurring of adjacent endplates, presence of bridging bone in the interbody space, and no evidence of loosening or motion on

flexion lateral radiographs. The follow-up radiographs were evaluated by an independent examiner.

We summarized outcomes with respect to pain and functional status. The differences between preoperative and postoperative scores were also determined and summarized. We defined success with respect to pain and functional status as an improvement of at least two levels between preoperative and postoperative scores. For analysis of follow-up data, we used the nonparametric tests for paired samples, and the correlation was evaluated using the Wilcoxon signed ranks test. A probability value of <0.05 was considered significant. All statistical analyses were performed using SPSS version 10.0 software (SPSS, Chicago, IL).

RESULTS

The fused level at which the ALIF procedure was performed was as follows: L3–L4 (1 patient), L4–L5 (14 patients), and L5–S1 (7 patients). In our series, the average preparation time was 25.7 minutes (range 15–45 minutes), and the average procedure time was 76.5 minutes (range 50–110 minutes). The mean time interval between the previous discectomy and ALIF was 52.8 months (range 14–108). The average estimated blood loss was 157 mL (range 50–600 mL). The average length of hospital stay was 5.5 days (range 4–10 days). In all patients, epidural scar tissue dorsal to the disc contained herniated disc fragments adjacent to the annular defect from the previous discectomy site. Figure 1 demonstrates complete removal of

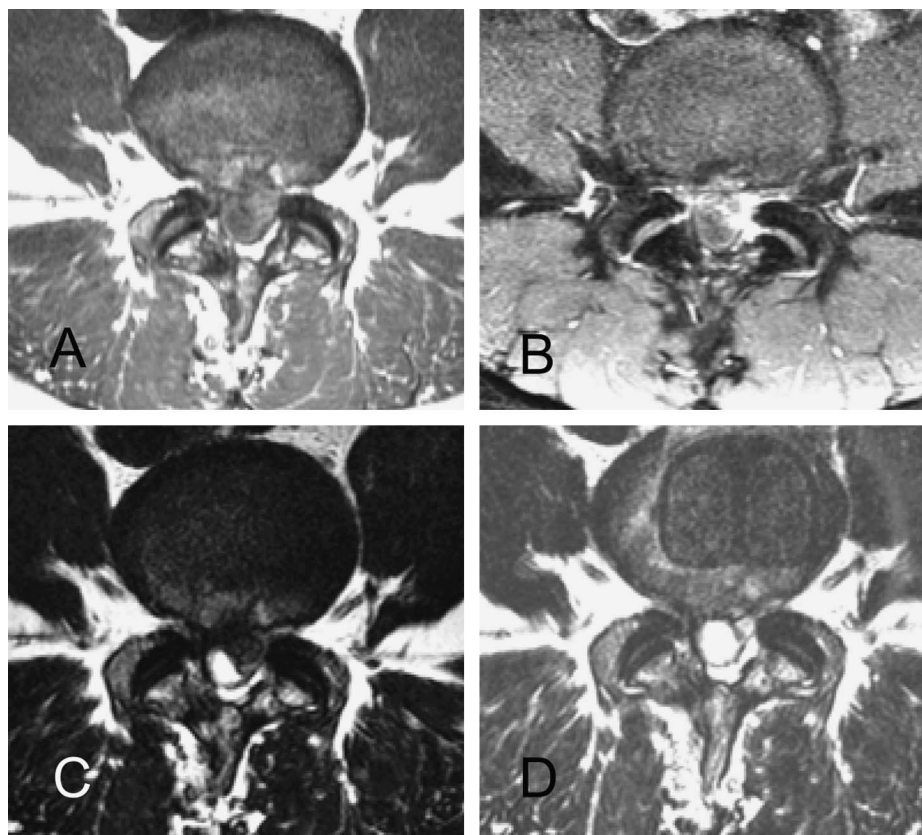


FIGURE 1. A and C, A series of axial T1-weighted (A) and T2-weighted (C) MR images revealing a large recurrent disc herniation. B, Postgadolinium T1-weighted images demonstrate peripheral enhancement of the herniation. D, Follow-up T2-weighted images obtained 3 days after ALIF show complete removal of the recurrent disc herniation and cage placement.

recurrent herniated disc fragments observed by follow-up MRI.

Outcome measurements for all patients were completed preoperatively and at the last follow-up visit. The distributions of preoperative and postoperative leg pain, back pain, and functional scores are presented in Figure 2. There was a statistically significant improvement between preoperative and postoperative scores for leg pain, back pain, and function (all $P < 0.001$).

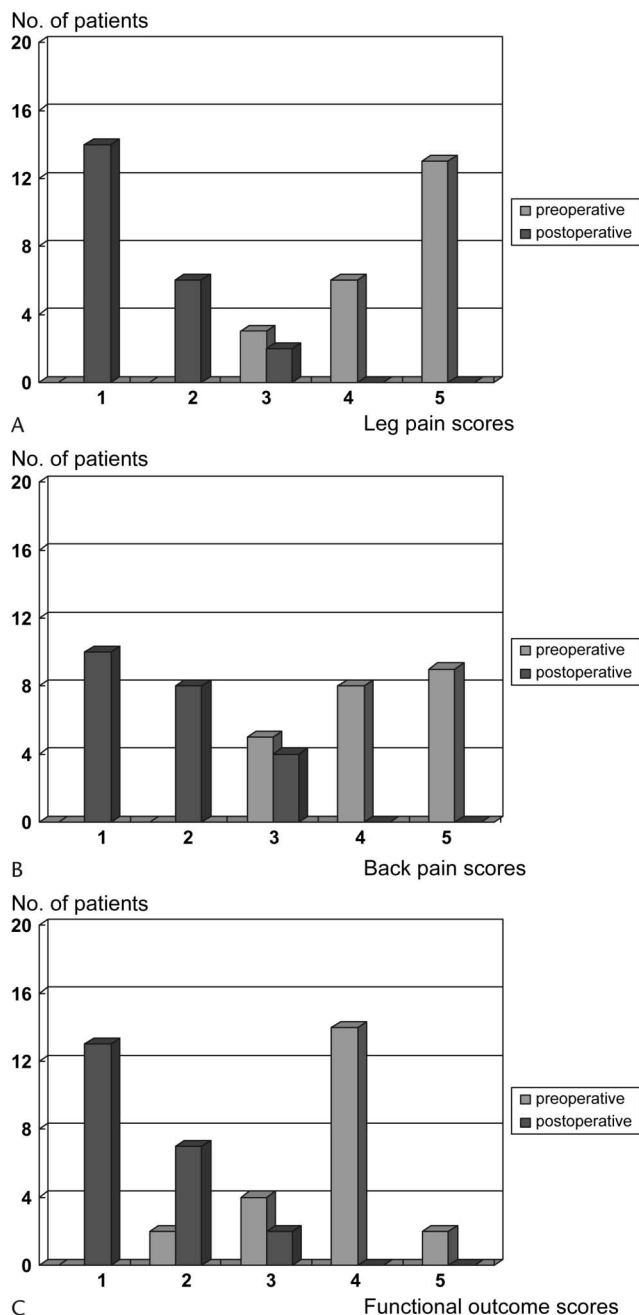


FIGURE 2. Comparison of preoperative and postoperative scores. A, Leg pain scores; B, back pain scores; C, functional outcome scores.

Nineteen of the 22 patients(86.3%) stated that they would undergo the same surgery for the same outcome (PSI of 4 or 5), and 3 patients indicated they were not sure (PSI of 3) (Table 4).

Nineteen patients (86%) achieved our definition of successful outcomes with regard to leg pain (see Fig. 2A). Preoperatively, all patients had significant back pain (scores of >3), whereas postoperatively, 77% (n = 17) achieved successful outcomes with regard to their back pain (see Fig. 2B). Finally, functional improvement occurred in 82% of patients (n = 18) (see Fig. 2C).

Solid fusion was found to be solid in all patients based on the determined criteria. One complication was noted in the current study: A patient sustained a iliolumbar vein tear during dissection, with intraoperative blood loss of approximately 600 mL, which required an immediate intraoperative ligation with hemoclip.

Illustrative Case

A 40-year-old woman presented with a 6-month history of radiating pain in the right leg and intermittent low back pain refractory to conservative treatment. Previously, the patient had undergone an open lumbar discectomy at L4–L5, which completely relieved her symptoms. Spinal MRI revealed a recurrent disc herniation with disc degeneration at the same level (Fig. 3). The patient underwent L4–L5 ALIF and serial radiographs, including lumbar CT scan, which were obtained 1, 21, and 36 months after surgery and demonstrated a solid fusion.

DISCUSSION

In 2001, Vishteh and Dickman reported on anterior lumbar microdiscectomy and interbody fusion for the treatment of recurrent disc herniation.¹² They described only six patients in whom anterior lumbar microdiscectomy was performed in conjunction with ALIF. They concluded that recurrent herniated disc fragments could be removed completely and that ALIF provided an alternative for the treatment of recurrent lumbar disc herniation. To our knowledge, no data have since been published that describe the clinical outcome after ALIF for recurrent lumbar disc herniation.

By contrast, this study reports our experience with 22 patients who underwent the ALIF procedure to treat recurrent lumbar disc herniation with a mean follow-up duration of 35 months. Therefore, the authors were able to assess the availability of ALIF for recurrent lumbar disc herniation with a relatively large population and an acceptable follow-up duration.

ALIF, first described by Burns⁷ in 1933, simultaneously accomplishes multiple goals in the treatment of recurrent

TABLE 4. PSI with Outcome at Last Follow-Up Visit

PSI	1	2	3	4	5
No. of patients	0	0	3	1	18

Question: “Would you have the same treatment again for the same outcome?” 1 = definitely not; 2 = probably not; 3 = not sure; 4 = probably yes; 5 = definitely yes.

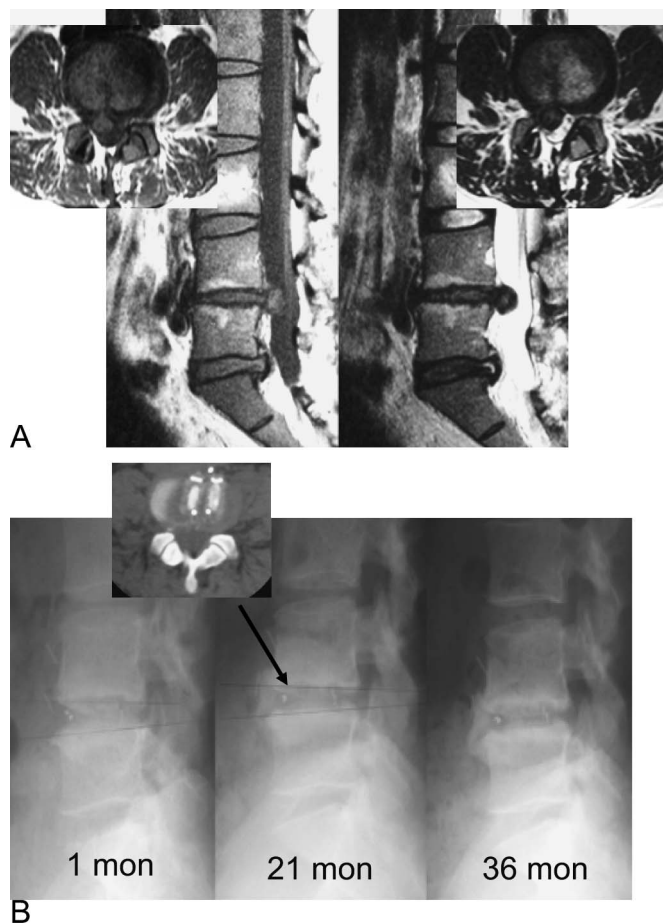


FIGURE 3. A, Spinal MRI revealing a recurrent disc herniation with degenerative disc change at L4–L5: left (T1-weighted image) and right (T2-weighted image). B, Series of post-operative radiographs demonstrate solid fusion. No evidence of adjacent segment degeneration is noted on the radiograph obtained 36 months after surgery.

lumbar disc herniation.¹³ First, it provides surgeons with a wide exposure of the entire disc space through virgin, unscarred tissue. It avoids dissection of perineural scar tissue, retraction of scarred nerve root and dura, and the removal of facets usually associated with repeat discectomy. ALIF preserves all remaining posterior paraspinal tissues (laminae, facets, ligaments, and muscle), thereby preserving spinal stability, which may help reduce the degeneration of adjacent motion segments. Second, it completely evacuates all disc material from within the disc interspace, which in turn minimizes, if not eliminates, the chance of recurrent disc herniation. All recurrent disc herniations were contained by epidural scar tissue to the region adjacent to the disc space. This feature facilitates the total removal of recurrent disc fragments only if they have not migrated downwardly or upwardly. Finally, ALIF allows a more efficient restoration of disc interspace height and decompression of the intervertebral foramen and permits treatment of foraminal stenosis by distracting the affected degenerated segment and placing interbody fusion devices.

The technical aspects of ALIF at L5–S1 are also important. The inclined angle of the disc space may be so steep that it renders adequate visualization of the posterior disc margin very difficult. Therefore, in the presence of a steeply inclined angle of the L5–S1 disc space, a 1-cm longer skin incision toward the symphysis pubis is recommended.

The ALIF procedure is technically demanding. The disadvantages of ALIF include the risk of injury to the great vessels or the presacral plexus, which in men may result in retrograde ejaculation. Regan et al¹⁴ reported the incidence of complications following open anterior lumbar surgery. For a series of 942 patients between 1963 and 1990, the most common complications were thrombophlebitis, urinary retention, and warm leg sensations. The rate of complications was reported to be <10%. Nevertheless, it is important to note that injury to the great vessels may be life threatening.

The risk of retrograde ejaculation in a young man warrants consideration during the decision-making process. Retrograde ejaculation resulting from injury to the superior hypogastric plexus had a reported incidence of 0.42% in a series of 4500 open anterior lumbar approaches, with 25–50% of occurrences being transient.¹⁵ Surgeons need to be made aware of the increased risk associated with the use of monopolar cautery and instructed to avoid its use to prevent retrograde ejaculation. We suggest that posterior approaches to the lumbar spine may be more appropriate than anterior approaches in young men of reproductive age. In our study, there were no complications such as great vessel injury or retrograde ejaculation that we mentioned above.

It is controversial whether interbody fusion ameliorates clinical results when recurrent disc fragments are resected. In the literature, however, clinical results following repeat discectomy are associated with lower success rates (60–80%)^{3–6,16} compared with primary microdiscectomy (80–90%).^{17–20} On the contrary, ALIF certainly provides several theoretical advantages as described earlier.^{21–24} From a biomechanical standpoint, the interbody fusion device is placed at the weight-bearing center of the spine across the degenerated disc space where 80% of the axial load occurs.²⁵ Furthermore, disc height and sagittal balance can be restored because optimal conditions are created by placing the interbody fusion device under compression with an extensive blood supply from the adjacent vertebral endplates.²¹ Clinical success in relieving preoperative symptoms was achieved in approximately 80% of our patients. A statistical trend was also observed in correlation with preoperative diagnoses of pain and functional outcomes. Based on these clinical outcomes as well as the theoretical advantages of ALIF, the authors found ALIF to be an effective procedure with satisfactory clinical results for the treatment of recurrent lumbar disc herniation.

Our study has the following limitations. It is not a comparative study. Our outcomes can be compared with similar studies involving other fusion techniques, but the patient population was small and no control group was included. Our goal was merely to present our early results with this procedure and to offer it as a reasonable alternative in patients with a previous discectomy, who have intractable radicular pain combined with back pain refractory to conservative treatment.

CONCLUSION

The authors found ALIF to be an effective procedure with satisfactory clinical results in selected patients with recurrent disc herniation in the lumbar spine. It seems that ALIF can be an alternative in the treatment of recurrent lumbar disc herniation.

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