Transforaminal lumbar interbody fusion in iatrogenic lumbar instability

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Background
Lumbosacral instability is one of the causes of failed back surgery syndrome, and it is characterized by loss of disc height with translational and in many cases rotational instability in the sagittal plane. Transforaminal lumbar interbody fusion (TLIF) is a modification of posterior lumbar interbody fusion that requires less retraction of the thecal sac and neural element. TLIF corrects most of the pathologies in patients with iatrogenic lumbar instability as it provides rigid stabilization of the spine with high incidence of fusion, decompression of central and lateral recess with facet and disc resection, restoration of disc and foraminal heights together with sagittal plane deformity correction.
Aim
This study was carried out to evaluate the efficacy of TLIF in the treatment of patient with iatrogenic lumbar instability.
Patients and methods
A total of 16 cases were diagnosed as iatrogenic lumbar instability according to the radiological method proposed by Dupuis and colleagues. Sex distribution was nine females and seven males. Plain radiograph (static and dynamic) and MRI with gadolinium enhancement were done for all patients. Single-level transforaminal lumbar interbody fusion (TILF) was performed in 11 cases and double-level TLIF was performed in five cases. Clinical evaluation was made using Oswestry disability index. Patients were examined for occurrence of solid interbody fusion at 9- and 12-month follow-up visits.
Result
A total of 14 patients showed obvious clinical improvement with reduction of their Oswestry disability index from 76.75% preoperatively to 36.9% at 6 month and 22.7% after 1 year. Overall, two cases had shown no clinical improvement: one had deep wound infection and the other had pseudoarthrosis. Solid fusion occurred in 14 (87.5%) cases. One case with pseudoarthrosis was the patient who had developed deep wound infection; the other case was a patient undergoing double-level TILF with pseudoarthrosis at L5–S1.
Conclusion
TLIF is a safe and effective technique in the treatment of patients with postlaminectomy lumbar instability with minimal complication rate.

Keywords:
iatrogenic instability, interbody fusion, transforaminal lumbar

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Introduction

Transforaminal lumbar interbody fusion (TLIF) is a well-established technique in the treatment of degenerative disorders of the lumbosacral spine, and it was described by Harms and Jeszesky [1] as a modification of posterior lumbar interbody fusion (PLIF). Both procedures can provide circumferential spinal stabilization through a posterior single approach, but the more lateral exteracanal access to the disc space in the TLIF requires less retraction of the thecal sac and neural element .This has been shown to reduce the incidence of postoperative radiculitis, less epidural scarring, and less incidence of dural tear, especially in previously operated patients [2,3].

Lumbosacral instability is one of the causes of failed back surgery syndrome complicating the postoperative course. Iatrogenic lumbar instability is characterized by loss of disc height with translational and in many cases rotational instability in the sagittal plane and it may be associated with concomitant disc pathology, spinal canal stenosis (central and lateral recess), and epidural scarring [4,5]. TLIF corrects most of the pathologies in patients with iatrogenic lumbar instability as it provides rigid stabilization of the

spine with high incidence of fusion, decompression of central and lateral recess with facet and disc resection, restoration of disc and foraminal height together with sagittal plane deformity correction [6].

Lumbosacral instability is a concept that is difficult to define, hard to diagnose, and difficult to treat. Clinical instability exists when sudden motion such as a visible slip or catch is observed during active movements of lumbar spine, but the validity of these findings remains largely unreported [7].

Radiological lumbosacral instability is defined when there is an anterior slip of 5 mm or more in lumbar spine or a difference in the angular motion of two adjacent motion segments more than 11° from L1 to L5 and motion greater than 15° at L5–S1 compared with L4–L5 [8].

We hypothesize that the aim of the study is to evaluate if TLIF is an effective and relatively safe technique in the treatment of patients with iatrogenic lumbar instability with favorable clinical and radiological outcome.

Patients and methods

We treated 16 patients diagnosed as having iatrogenic lumbar instability with transforaminal lumbar interbody fusion (TILF) and posterior pedicle fixation at the Zagazig University Hospital between May 2012 and June 2014. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Zagazig University, Egypt. The study was approved by the ethical committee of Orthopedic Department of Zagazig University. Patients with previous instrumentation or fusion were excluded from the series. Mean patient age was 45.63 years, with a range from 33 to 61 years. Sex distribution was nine females and seven males.

All patients were assessed with thorough history and careful examination. Plain (static and dynamic) radiographs and MRI with gadolinium enhancement were done for all patients to assess level, type, and degree of instability; extent of previous laminectomy; concomitant disc herniation; spinal canal stenosis; and exclusion of epidural scarring and arachnoiditis as cause of patient complaints.

All patients fulfilled the radiological criteria of lumbosacral instability proposed by Dupuis *et al.* [9]. In this study, the patients were considered to have instability if dynamic films revealed anterior translation more than 4 mm at lumbar level and more than 5 mm at L5–S1 level and also when radiography showed more than 20° angulation differences between lateral flexion and extension views.

Oswestry disability index was used for clinical evaluation. The patients were asked to answer the sheet preoperatively and postoperatively at 6-month and 12-month follow-up visits. Radiological assessment was made for occurrence of solid fusion and absence of implant failure on radiograph images done at 9-month and 12-month follow-up visits.

Surgical technique

All patients had general anesthesia with endotracheal intubation. The patients were positioned in prone position with a special four postframe to allow the abdomen to hang free and reduce epidural venous pressure. The hips and knees were slightly flexed to relieve tension on nerve roots and to preserve lumbar lordosis in order not to fuse the spine in flat position.

The posterior spine structures were exposed with two important technical points to avoid neural tissue injury in previously operated patients as dissection was started from proximal to distal to find depth of neural tissue and from lateral to medial to enter the canal from normal side and avoid dural injury. Pedicle screws were inserted in standard fashion under fluoroscopic guidance.

Exposure of the operating window is done by removing the facet joint, hemilamina, and pars interarticularis if present on the side consistent with patients' symptoms using a Kerrison rongeur or an osteotome. The thecal sac, exiting nerve root, traversing nerve root, and disc space is visible. Nerve root retractors are applied to protect the dura and exiting nerve root. The annulus is incised to open a large posterolateral window wide enough to permit adequate preparation of the disc space. Discectomy is performed and then sequential dilators are used to open the disc space. After distraction of the disc space, the pedicle screws on the contralateral side are tightened to maintain disc space distracted. End plates were prepared using angled curettes and rasps with different sizes.

Autologous bone graft either from posterior element after decompression or from posterior iliac crest is harvested or prepared. Bone graft is packed into the anterior and contralateral portion of the disc space to increase possibility of fusion. A trial cage is then inserted to verify adequate size. The cage of appropriate size is then inserted after being filled

with autologous bone graft. Distraction of the contralateral screw is released. Then rods are applied and screws are tightened in slight compression to increase compression loads on the cage.

Bone graft is applied on the contralateral transverse processes after being decorticated to allow for achievement of circumferential fusion. A suction drain is applied, and the wound is closed in layers. An orthosis was worn for 3 months. Patients were encouraged to ambulate as early as the first postoperative day.

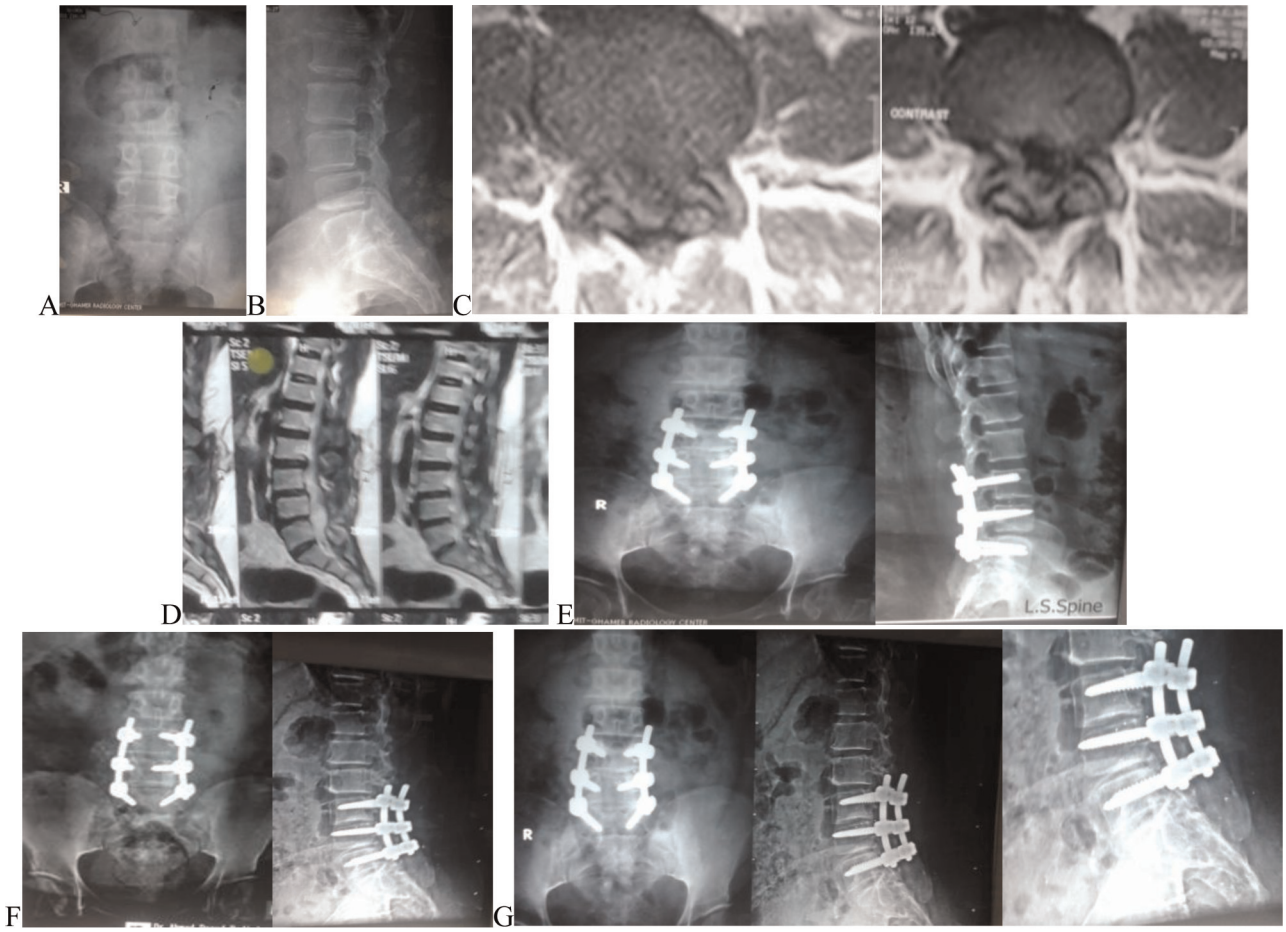
Result

TILF was performed in a single level in 11 cases (L3–L4 in two cases, L4–L5 in five cases, and L5–S1 in four cases) and double level (L4–S1) in five cases. The mean operative time was 205.5 min. The average length of hospital stay was 3.94 days. The estimated mean blood loss was 257 ml. The follow-up period ranged from 13 to 20 months, with a mean period of 16.75 months.

Operative complication in the form of dural tear occurred in two (12.5%) cases which were adequately repaired with no postoperative cerebrospinal fluid leakage. Pedicle screw malposition occurred in one patient and required no further management.

Postoperative deep wound infection occurred in one case who was admitted a second time, where the wound was open, debridement and lavage were done, and screws were found stable and were not removed.

Figure 1



A 54-year-old male patient presented mainly with a complaint of LBP and decreased walking distance since 3 years with failed conservative treatment for 2 months. He was diagnosed as having lumbar spinal canal stenosis and underwent laminectomy from L3 to L5. His neurogenic claudication was improved but after 1 year, he reported marked increase in his back pain and recurrence of LT sciatica. Radiograph revealed anterolisthesis of L3 over L4 with laminectomy defect from L3 to L5 (a) A-P image and (b) standing lateral image. Enhanced MRI showed lumbar disc prolapse L4–L5 with anterior listhesis of L3 over L4 (c) axial T1 MRI image at L4–L5 with and without contrast and (d) sagittal T2 image. The patient was operated by TLIF at L3–L4, discectomy of L4–L5, with posterior fixation of L3 to L5 (e) immediate A-P and lateral postoperative images, (f) 6-month postoperative A-P and lateral images and (g) 12-month postoperative A-P, lateral, and cone-down images. The patient was followed up for 14 months, with marked improvement of his back pain and sciatica. ODI reduced from 72% preoperatively to 28% postoperatively at 12-month follow-up visit. A-P, anteroposterior; LBP, lpw back pain; ODI, Oswestry disability index; TLIF, transforaminal lumbar interbody fusion.

Postoperative transient radicular manifestation occurred in three cases (one on the same TLIF side and two on the contralateral side) with partial foot drop in one patient who regained full strength 6 months postoperatively.

A total of 14 patients showed obvious clinical improvement with reduction of their Oswestry disability index (ODI) from 76.75 preoperatively to 36.9% at 6 months and 22.7% after 1 year. The two (12.5%) cases with no clinical improvement had deep wound infection in one case and pseudoarthrosis in the other case with persistent back pain (Figs 1–2).

Solid fusion occurred in 14 (87.5%) cases. One case with pseudoarthrosis was the patient with deep wound infection; the other case was a patient undergoing double-level TILF with pseudoarthrosis at L5–S1.

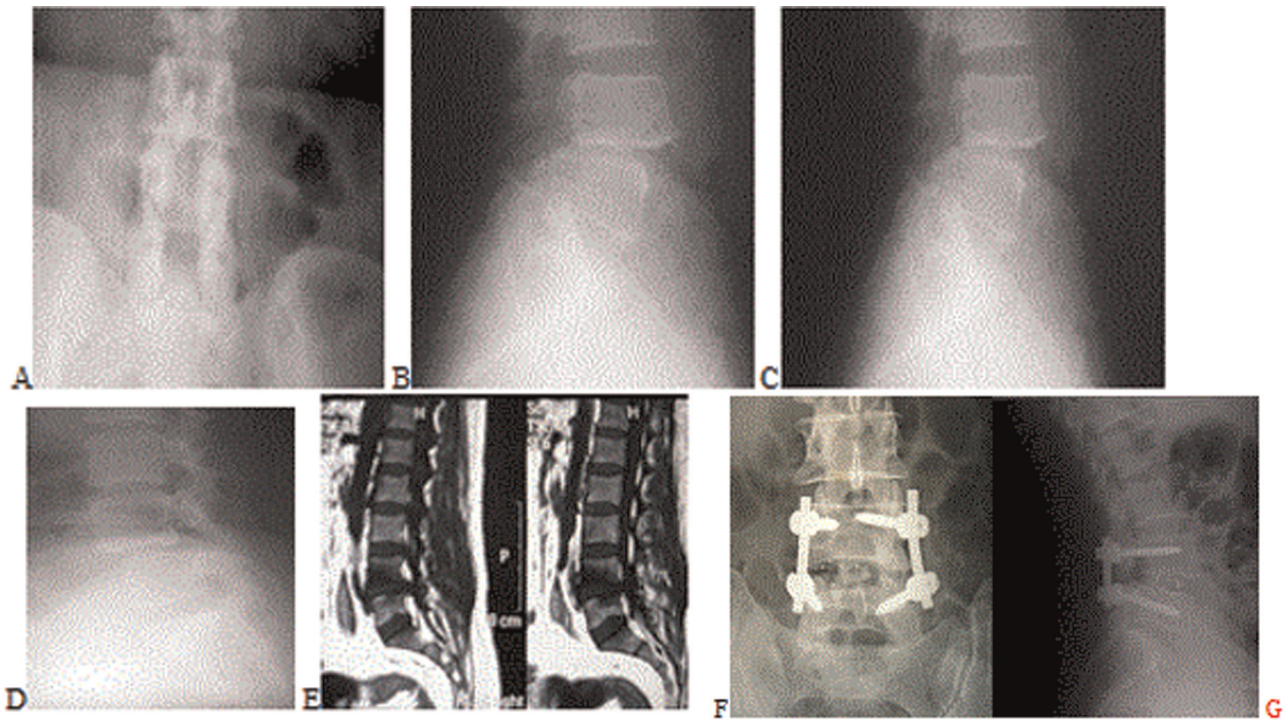
Discussion

Instability is a common postoperative sequala of disc excision and decompressive surgery. It may occur after microsurgery and standard surgery. It is one of the causes of failed back surgery syndrome that may affect outcome of lumbar surgery [9].

Surgical treatment of iatrogenic lumbar instability should be based on patient symptom and results of imaging study. If signs of persistent stenosis are present, decompression is performed with fusion. Isolated instability particularly dynamic is usually addressed with fusion and segmental instrumentation [10]. For those patients with resulting deformity, restoration of spinal alignment is needed. This may involve a combination of anterior and posterior surgery [11].

Interbody fusion has gained acceptance in the treatment of motion segment instability pain. It has multiple advantages over posterolateral fusion. First, it places the bone graft in the load-bearing position, and then, subject it to compressive forces that enhance bony fusion as predicted by Wolff's law. Second, it provides wide osseous surface area with a more generous vascular supply than the posterolateral element, which further improves fusion potential. Third, interbody fusion can better restore coronal and sagittal balance. Fourth, it is radiologically easier to differentiate between successful

Figure 2



A 40-year-old male previously operated for LBP and right sciatica by laminectomy and discectomy at L4–L5 level since 2 years. Plain radiograh showed anterior translation of L4 over L5, bilateral pars defect, and laminectomy defect (a) A-P image, (b) standing lateral image, (c) lateral flexion image, and (d) lateral extension image. Enhanced MRI revealed compression of right L5 nerve root with lateral recess stenosis at L4–L5, (e) sagittal and axial MRI images. The patient was operated with right-sided TILF L4–L5 with posterior pedicle fixation (f) immediate postoperative A-P and lateral images. The patien was followed up for 16 months with clinical improvement of ODI from 86% preoperatively to 24% at 12-month follow-up visit. Solid fusion occurred after12 months (g) 12-month postoperative lateral image). A-P, anteroposterior; LBP, lpw back pain; ODI, Oswestry disability index.

fusion from pseudoarthrosis in interbody fusion than posterolateral fusion [12].

In the literature, interbody fusion either posterior or anterior has advantages over the posterolateral fusion regarding maintenance of disc space height, higher spinal construct stiffness, maintenance of spinal alignment, and higher fusion rate [13–15].

In this study, significant clinical improvement in pain, function, and quality of live was observed as demonstrated by obvious reduction in ODI from 76.75% preoperatively to 22.7% at 12-month follow-up visit. TLIF avoids the need for dural retraction present when performing a PLIF, which may increase the potential for complications such as neuropraxia and dural laceration. Several studies showed that TILF gives superior results with less complication rate than PLIF [16]. In this study, dural tear had occurred in only two cases.A radiographic fusion rate from 85 to 100% had been shown in several studies in segmental lumbar instability including secondary instability, for example, postlaminectomy instability [17]. These results are comparable with our fusion rate (87.5%)

Conclusion

TLIF is an effective and relatively safe technique in the treatment of patients with iatrogenic lumbar instability with good clinical outcome and high incidence of spinal fusion together with minimal complication rate.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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