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TRANSFORAMINAL LUMBAR INTERBODY FUSION IN MANAGEMENT OF DEGENERATIVE LUMBAR SPINE DISORDERS

By

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ABSTRACT

Background: Interbody fusion represents an efficient surgical treatment in degenerative lumbar spine disorders, achieving satisfying outcome in >90% of cases. Various studies have affirmed the advantages of TLIF techniques with regard to achieve 360 degree fusion, but their efficacy in showing the results of TLIF in treatment of different lumbar spine degenerative disorders has not yet been demonstrated.

Objectives: Assessing the clinical and radiological outcomes of transforaminal lumbar interbody fusion (TLIF) in the management of degenerative lumbar spine disorders, and to demonstrate the safety, surgical efficacy, and advantages of the transforaminal approach for lumbar interbody fusion.

Patients and Methods: Twenty patients with degenerative lumbar spine disorders were treated with TLIF and were followed up for 18 months. The clinical outcomes were assessed by Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) questionnaire.

Results: Low back and leg pain completely resolved in 18 patients (90%). Solid fusion was achieved in 18 patients (90%), whereas pseudarthrosis was documented in two patients.

Complications reported post-operatively; Dural tear reported in 2 cases (10%), early post-operative wound infection reported in one case (5%)**,** neurological deficit reported in one case (5%), Cage subsidence reported in one case (5%), Pseudo arthrosis reported in 2 cases (10%) and poor improvement of low back pain also reported in 2 cases (10%).

Conclusions: TLIF is a safe and effective method in treatment of degenerative lumbar spine disorders for achieving circumferential spinal fusion via a single stage procedure.

Key Words: Degenerative lumbar spine – Transforaminal approach- interbody fusion.

INTRODUCTION

Approximately 70% to 85% of adults will be affected by low back pain (LBP) at some point during their lifetimes. Numerous anatomic sites can be responsible for the pain, and accurate diagnosis is often difficult. Degenerative disc disease (DDD), internal disc disruption, lumbar disc herniation, and facet joint arthritis, as well as intra-abdominal pathology, are all potential causes of LBP **(Andersson, 1999)**.

The spectrum of degenerative spinal diseases includes degenerative disc diseases, facet joint arthritis, spinal stenosis, degenerative spinal scoliosis and spondylolisthesis **(Middleton and Fish, 2009)**.

Patients with DDD or discogenic back pain can present with a constellation of symptoms that range from benign LBP to excruciating back pain with lower extremity symptoms **(Carragee and Hannibal, 2004)**.

Conservative management has always been advocated for these patients prior to surgical management **(Roh et al., 2005)**. Although properly selected patients are likely to benefit from surgery, under the circumstances of a non-emergency situation, most patients prefer conservative approaches comprising of physiotherapy, acupuncture and lifestyle modifications **(Mummaneni et al., 2004).**

For the small number of patients with severe, recalcitrant pain, lumbar fusion may be required, particularly when concomitant leg pain or deformity is present **(Deyo et al., 2004)**.

Methods of spinal arthrodesis continue to evolve in efforts to treat back pain. The latest techniques include approaching from anterior, posterior, lateral and posterolateral. Interbody fusion techniques have been developed to provide solid fixation of spinal segments while maintaining load bearing capacity and proper disc height **(Stonecipher and Wright, 1989)**. Interbody fusion techniques provide better fusion and are very effective in the preservation of disc height **(Mura et al., 2011).**

The ability to reconstruct the anterior column after disc removal is important because 80% of the compressive, torsion, and shear forces are transmitted through the anterior column **(Harms, 1992)**.

Reconstruction of the anterior column can be performed via the anterior approach, with direct transperitoneal or retroperitoneal access to the lumbar spine. Posterior fusion and instrumentation can be added to obtain a 360 degree fusion. This technique involves two surgical approaches, with increased operating time (compared to posterolateral fusion) as well as potential complications related to anterior approach to the lumbar spine. An alternative method of reconstructing the anterior column is via posterior lumbar interbody fusion **(Yang et al., 1986)**.

The transforaminal lumbar interbody fusion (TLIF) developed by Harms is a modification of the posterior lumbar interbody fusion (PLIF) **(Harms and Jeszenszky, 1998)**. The TLIF has been shown to be valuable alternative to the traditional PLIF **(Whitecloud et al., 2001)**.

Advantages of the TLIF over PLIF are fewer complications, avoidance of epidural scarring, less intraoperative bleeding, and avoidance of dural injury. Further, given its unilateral approach, better preservation of the lumbar spine musculoligamentous complex is obtained **(Harms and Jeszenszky, 1998)**.

PATIENTS AND METHODS

Prospective study was conducted between 2012 and 2014 in Bab El Shaareya University Hospital, Al-Azhar University involving 20 patients with degenerative lumbar spine disorders were treated operatively by TLIF technique using a PEEK Cages with pedicular screws and rods. Before starting study consent was taken from all patients. The

inclusion criteria were: (1) Patients with degenerative disc diseases with or without disc herniation; (2) patients with degenerative spondylolisthesis; (3) patients with Spinal canal stenosis with instability; (4) patients with failed previous lumbar surgery. Exclusion criteria were lumbar spine infections or tumors. All cases tried conservative measures for at least three months. The patients were twelve males and eight females. The average age at surgery was 45 years (36-62). 16 patients had a one-level fusion, most commonly affected level L4-L5 (10 patients), followed by L5-S1 (4 patients) and L3-L4 (2 patient). 4 patients had two levels of involvement.

Clinical and Radiologic Evaluations: All patients in this study were carefully assessed clinically in the form of detailed clinical history and thorough general and local examinations. We used Visual Analogue Scale (VAS) for pain assessment and Oswestry Disability Index (ODI) for disability and quality of life assessment. **Fairbank and his Colleagues (1980)** interpreted "percentage of disability" scores in this manner:

- ***0% to 20% - minimal disability:*** In this group, the patients can do most of the normal daily activities. For most cases, no treatment is needed but the patients should take care while lifting, sitting, keep fit and control their body weight.
- ***20% to 40% - moderate disability:*** In this group, the patients have more pain with standing, sitting and lifting. Travelling and social life is more difficult. Work ability can be limited. Self-care, sexual activity and sleep have in most cases no problem. The low back complaint can be treated conservatively.
- ***40% to 60% - severe disability:*** Pain is the main complaint of this group. Walking, self-care, social life, sexual activity and sleep are affected. These patients need consideration for operative treatment.
- ***60% to 80% - crippled:*** The back pain handicaps the patients from all life situations at home and at work. Limitations of all daily activities are encountered. Operative treatment is most probable. Alternative treatment is an intensive pain therapy course.
- ***80% to 100% - bed bound (or exaggerating symptoms):*** These patients are either bed bound or show exaggerated symptoms due to their back pain. They should be noticed during their medical treatment and evaluated.

For radiographic examination, standing anterior-posterior and lateral radiographs of the lumbar spine were performed. Flexion-extension lateral radiographs taken in the standing position were also done to discover whether hypermobility exists at the spondylolisthetic level. Magnetic Resonance Imaging (MRI) was done for all patients preoperatively to demonstrate any impingement of the central spinal canal from disc herniation, degenerative spondylosis, or other conditions.

Surgical Technique: Using the midline posterior approach bilateral dissection was extended just lateral to the facet joints. Trans-pedicular screws were inserted in the usual fashion. On the symptomatic

side, the pars interarticularis was removed and a hemifacetectomy performed on the superior and inferior facets at the level of the spinal segment to be fused. Complete discectomy was performed using disc rongeurs and curettes and rongeurs. End-plate decortication was performed. Intervertebral disc space spreaders were then sequentially inserted and rotated to restore the normal disc space height. Once the disc space was distracted, the anterior two-thirds of the disc space were packed with cancellous bone from the laminectomy bone. A single cage packed with bone was inserted posterolaterally and oriented anteromedially. Finally, connecting rods were placed and compression was applied across the instrumentation to restore segmental lordosis and was locked in place **(Abd El-Kader, 2016).**

Postoperatively, mobilization from bed with physical therapy began on post-operative day 1. Lumbar supports and braces were not used. Walking to tolerance was encouraged immediately. Patients were counseled to avoid heavy lifting and strenuous activity for at least 6 months, but were otherwise permitted to return to their jobs as soon as symptoms would allow. All activity limitations were generally lifted at 1 year postoperatively, independent of radiographic ?ndings, unless gross implant failure was apparent.

Statistical Analysis: The data collected were tabulated and analysed by SPSS (statistical package for social science) version 17.0. Data were presented as mean $\pm$ standard deviation. Statistical analysis were carried out using t test for independent samples and Paired sample t test. Probability values of 0.05 or less were considered statistically significant.

RESULTS

Assessment was mainly subjective using VAS for pain assessment pre-operative and at 6 weeks, 6 months, 12 months and 18 months postoperative, and also using ODI for disability and quality of life assessment pre-operative and at 6 weeks, 6 months, 12 months and 18 months postoperative. Plain X-rays were obtained at 3, 12 and 18 months postoperative to assess bony fusion.

Radiographic fusion: The post-operative antero-posterior, lateral radiographs and dynamic views were used to assess the fusion mass at each level. The plain radiographs were obtained at 3 months, 6 months, 12 months and 18 months postoperative to assess fusion status. Solid arthrodesis of the interbody space was confirmed by the presence of continuous bridging bone observed on the lateral radiographs, absence of lucencies around the cages, no cage migration or collapse and absence of halo around the screws. By Using this criteria, solid fusion was achieved in 18 patients (90%), whereas pseudarthrosis was documented in two patients.

Low back pain and leg pain were completely resolved in 18 patients (90%) according to VAS. All patients were rated minimal disability according to ODI (Table 1). The radiological outcome (Figures 1, 2) showed solid fusion was achieved in 18 patients (90%), whereas pseudarthrosis was documented in two patients.

Table (1): Comparison between VAS and ODI preoperative and after 18 months post-operative.

Methods / Parameters	VAS		Paired t-test		ODI		Paired t-test	
	Range	Mean ± S.D.	t	p-value	Range	Mean ± S.D.	t	p-value
Preoperative	4.0-9.0	6.9 ± 1.831	13.530	0.000	22	32.9 ± 4.981	18.651	0.000
After 18 months	0.0-1.0	0.08 ± 0.288			1	2.33 ± 1.302		

Figure (1A)

Figure (1B)

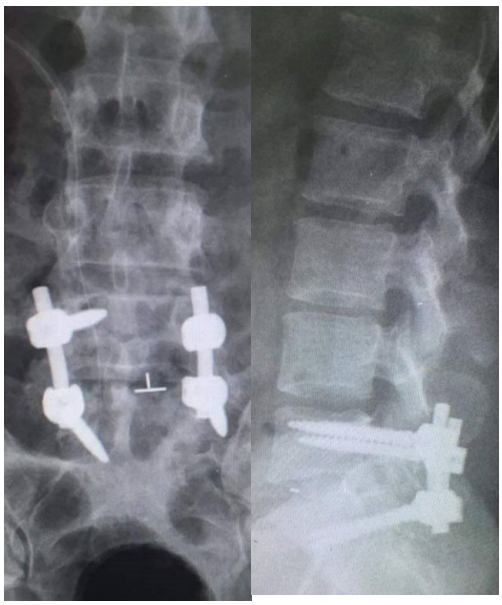

Figure (1C)

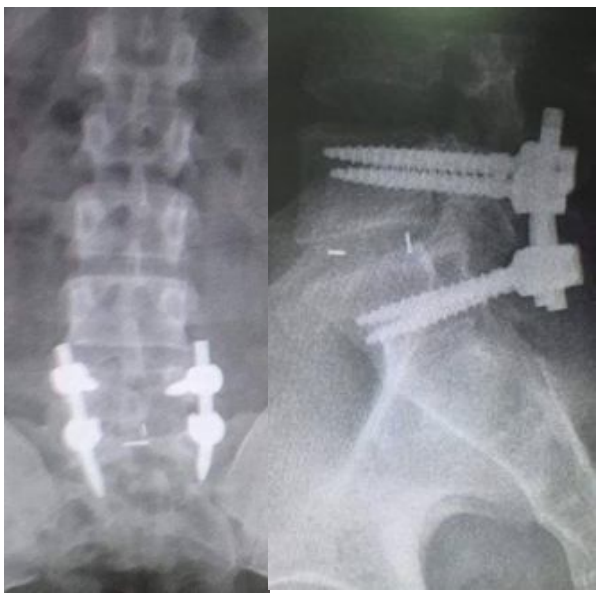

Figure (1D)

Figure (1): Case 3 with L.D.P L_5-S_1. (A) Preoperative radiograph anteroposterior and lateral views. (B) Preoperative MRI (C) Post-operative radiographs anteroposterior and lateral views. (D) At the 18-months follow up anteroposterior and lateral views radiograph.

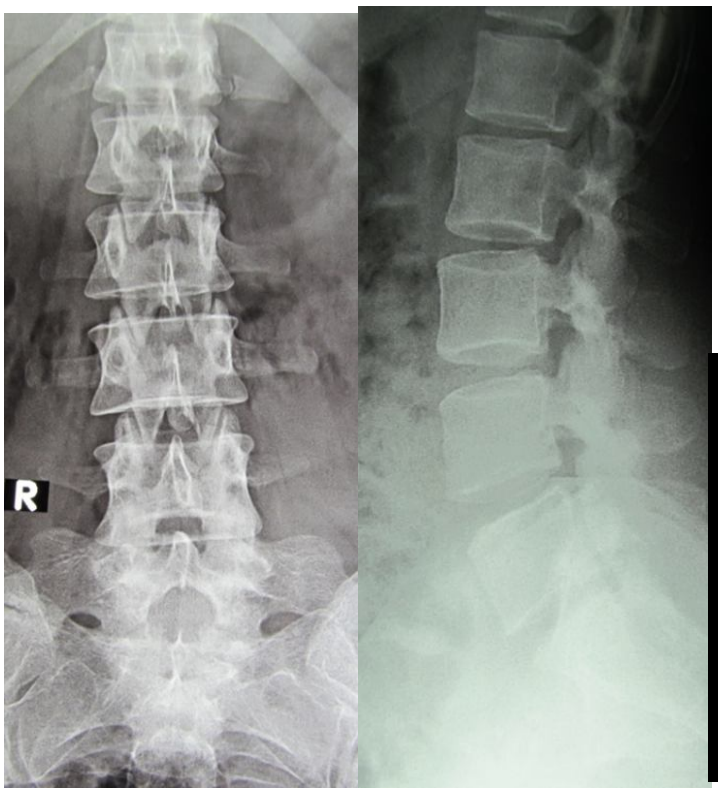

Figure (2A)

Figure (2B)

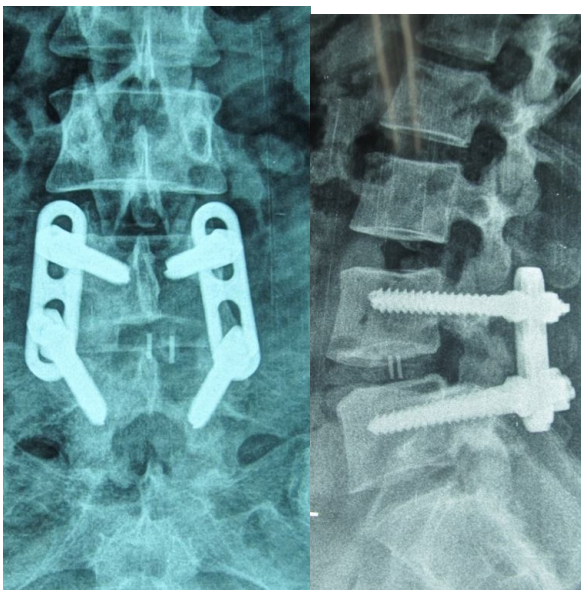

Figure (2C)

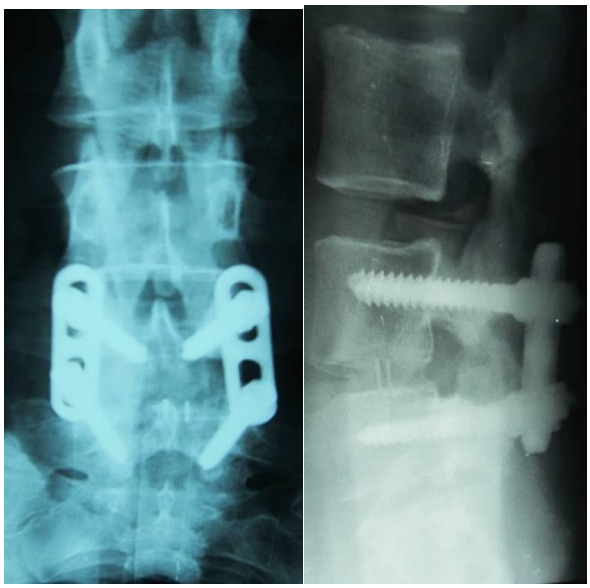

Figure (2D)

Figure (2): Case 9 with L.D.P L_{4-5}. (A) Preoperative radiograph anteroposterior and lateral views. (B) Preoperative MRI (C) Post-operative radiographs anteroposterior and lateral views. (D) At the 18-months follow up anteroposterior and lateral views radiograph.

DISCUSSION

Degenerative lumbar spine disorders are the commonest causes of low back pain. Lumbar arthrodesis contributed in solving this issue. TLIF is one of the modern techniques of lumbar arthrodesis which showed effective role in treating of lumbar pain caused by degenerative lumbar spine disorders **(Shunwu et al., 2010)**.

Clinical presentations in our study were mechanical back pain in 100% of cases and leg pain in 90% of cases. Female to male ratio was 1:4.

Indications of TLIF includes low grade spondylolisthesis, degenerative disc diseases, spinal stenosis, unilateral and recurrent disc herniation especially if lumbar fusion is needed in addition to posterior decompression **(Deng et al., 2008).**

Humphreys et al. (2001) concluded that the TLIF showed to be a good alternative to PLIF with relatively less risk of complications, less operating time and hospitalization, as well as significant reduction in blood loss during operation. We quite agree with this as regard our results. TLIF approach lessens the potential for nerve root injury, therefore resolving probably the most important limitation of the PLIF procedure. For this reason, and the case specific advantages of TLIF over a combined anterior and posterior single-level fusion, we favored TLIF over PLIF as the choice surgical procedure for the posterior operative management of symptomatic degenerative lumbar spine disorders.

Lowe and Tahermia (2002) reported in their study underwent TLIF surgery that fusion rate radiologically was 95% of cases and good to excellent clinical outcome was achieved in 88% of cases. In our study fusion rate was 90% and improvement in clinical symptoms was 90% of cases.

Deng et al. (2008) mentioned that lumbar pain improved in 83.5% of patients compared to 90% lumbar pain improvement in ours. **Audat et al. (2012)** reported that pain symptoms relieved in 70% of 81 patients, and good outcomes were reported in 80% of the patients. **Goldstein et al. (2014)** found a dural injury rate of 5.4%, graft malposition of 4.4%, screw mal-position of 2.6%, neurologic deficit and nerve injury of 3.8%, reoperation ratio of 3.3%, and reoperation for graft mal-position of 1.8% for PLIF and TLIF procedures.

Asil and Yaldiz (2016) reported that in his study overall complication rate was 23.9%, dural injury rate was 9.9%, graft mal-position rate was 2.82%, and the screw mal-position rate was 4.23%. In our study dural injury rate was (10%), early post-operative wound infection rate was (5%), neurological deficit rate was (5%), cage subsidence rate was (5%), Pseudo arthrosis rate was (10%) and poor improvement of low back pain rate was (10%).

CONCLUSION

TLIF is a technique which offers a simple, safe and effective treatment for degenerative lumbar spine disorders with great improvement of life quality of cases with surgery satisfaction.

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خلفية البحث: يعتبر العلاج عن طريق الإندماج ما بين أجسام الفقرات وسيلة جراحية فعالة لعلاج حالات التآكل بين الفقرات القطنية، محققا نتائج مرضية في أكثر من 90% من المرضي. وقد أكدت العديد من الدراسات مزايا طريقة الإندماج ما بين أجسام الفقرات عن طريق الفتحات الجانبية للقناة الفقارية وذلك بتحقيقها 360 درجة من الإندماج ما بين أجسام الفقرات، ولكن هذه الدراسات لم تظهر فعاليتها في إثبات فاعلية تلك الطريقة في علاج حالات التآكل ما بين أجسام الفقرات القطنية.

أهداف الدراسة: تقييم النتائج الإكلينيكية ونتائج الأشعات لعلاج حالات التآكل بين الفقرات القطنية عن طريق الإندماج ما بين أجسام الفقرات من خلال الفتحات الجانبية للقناة الفقارية، وللتدليل علي أمان وفاعلية طريقة الدخول عبر الفتحات الجانبية للقناة الفقارية في حالات الإندماج ما بين أجسام الفقرات.

المرضي وطرق البحث: تم علاج عشرين مريضا يعانون من تآكل في الفقرات القطنية بطريقة الإندماج ما بين أجسام الفقرات القطنية عن طريق الفتحات الجانبية للقناة الفقارية، وتم متابعة المرضي لمدة 18 شهراً. وقد تم تقييم النتائج الإكلينيكية عن طريق مقياس التناظرية البصرية وإستبيان مؤشر اوسفيستري للإعاقة.

النتائج: شفيت آلام أسفل الظهر وآلام الفخد تماما في 18 مريض (90 % من المرضي)، وأظهرت الأشعات حدوث إلتئام كامل بين أجسام الفقرات في 18 مريض (90 % من المرضي)، كما أظهرت عدم حدوث إلتئام بين الفقرات في إثنين من المرضي (10% من المرضي).

وقد تم تسجيل المضاعفات الآتية: قطع بالأم الجافية في إثنين من المرضي (10% من المرضي)، عدوي ميكروبية مبكرة في مريض واحد (5% من المرضي)، عجز عصبي في مريض واحد (5% من المرضي)، تغور للقفص القطني في مريض واحد (5% من المرضي)، عدم إلتئام بين الفقرات في إثنين من المرضي (10% من الحالات) ، وإستمرار آلام أسفل الظهر في إثنين من المرضي (10% من الحالات).

الاستنتاجات: الإندماج ما بين أجسام الفقرات القطنية عن طريق الفتحات الجانبية للقناة الفقارية وسيلة فعالة وآمنة في علاج حالات تآكل الفقرات القطنية لتحقيق إندماج كامل ودائري بين أجسام الفقرات القطنية عن طريق إجراء جراحة من مرحلة واحدة.