

Clinical and Radiological Outcome of Transforaminal Lumbar Interbody Fusion

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Abstract

Background: Spinal fusion is a therapeutic treatment for chronic low back pain evolved from failed disc procedure, disc degeneration, spondylolisthesis spondylosis and resistance to conservative management. Different methods of spinal fusion have evolved recently. Nevertheless, the optimal surgical technique is not conclusively supported by science. No enough data was found comparing the efficiency and transforaminal lumbar interbody fusion (TLIF) safety in comparison to other methods of spinal fusion in cases of spinal lumbar disorders especially lumbar spondylolisthesis.

Aim of Study: To analyze clinical, functional and radiological outcome, regarding pain, functional disability, fusion rate, and complications of cases managed with TLIF.

Patients and Methods: This Cross-sectional analytic study performed on 23 patients with single level spondylolisthesis not responding to conservative medical treatment. After verification clinically the patient underwent spinal fixation by TLIF technique. This study was conducted in Cairo University hospitals in the Neurosurgery department with detailed results shown below.

Study design: Prospective descriptive case series.

Results: Intraoperative and post-operative complications were seen in a time of 90 days and a statistical finding was noted. The Visual Analog Score (VAS) is a scale which can be used in questionnaires. The Oswestry Disability Index (ODI) is utilized by clinicians and specialists With respect to rates; In our review fusion rates couldn't be assessed because of the shortage of time for follow-up. As most cases need longer time of follow up for a considerable length of time as long as 1 year to have the option to evaluate fusion In this way, we are expecting to follow-up our review cases for longer period to have the option to follow fusion.

Conclusion: Each approach has its own risks and benefits with some similarities. Although is limited in number of cases and time of follow-up, it still shows and initial good experience

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with TLIF. In our study it shows good clinical and functional outcome regarding VAS score and oswestry disability index but it shows higher rates of complications and delayed fusion in comparison to other studies. Despited limitation of cases and shortage of time of follow-up might affect the result and outcome. We think that this method ought to be encouraged and used in certain situations. We have concluded that fixation with TLIF showed better outcome clinically, radiologically and functionally.

Key Words: Spinal fusion – Spondylolisthesis – TLIF.

Introduction

TECHNIQUES for interbody fusion have been developed to offer stable spinal segment fixation while preserving appropriate disc height and load-bearing capability [1]. Since the anterior column is known to transmit 80% of the compressive, torsion, and shear stresses, the capacity to reconstruct the column following disc removal is crucial [2,3].

The anterior approach allows for direct transperitoneal or retroperitoneal access to the lumbar spine during anterior column reconstruction. A 360° fusion can be achieved by combining posterior fusion with additional equipment. In comparison to posterolateral fusion, this technique requires two surgical approaches, which may result in longer recovery times. Additionally, anterior approaches to the lumbar spine may cause difficulties.

Reconstructing the anterior column with posterior lumbar interbody fusion is an alternate technique. The posterior lumbar interbody fusion (PLIF) was modified into the transforaminal lumbar interbody fusion (TLIF) by Harms [4]. Research has demonstrated the value of the TLIF as a substitute for the conventional PLIF [5,6].

Less problems, the avoidance of dura and nerve roots, the removal of epidural scarring, and reduced intraoperative bleeding are the benefits of TLIF over PLIF [5]. Additionally, because of its unilateral

approach, the lumbar spine's musculoligamentous complex is better preserved.

It has been demonstrated that the conventional strategy, which combines laminectomy with posterior lumbar interbody fusion (PLIF), produces acceptable clinical results. Nonetheless, it entails the dissection of both paraspinal muscles and a large amount of the posterior midline structures, such as the interspinous ligaments, spinous processes, and supraspinous ligaments [7].

Not enough data was found comparing the efficiency and safety of TLIF in comparison to other methods of fixation in cases of Spinal lumbar disorders especially lumbar spondylolisthesis in developing countries; our study aim to investigate the efficiency, safety and outcome of TLIF in cases of spondylolisthesis regarding clinical, radiological and functional outcome and the complication rates.

Aim of the study:

To analyse outcomes regarding pain, rate of fusion, functional disability, and complication of subjects managed with TLIF.

Patients and Methods

Methods:

This review was directed upon 23 patients experiencing lumbar spine problem (spondylolisthesis). These patients were worked Upon by TLIF with bilateral pedicular screw fixation in Kasr Al-Ainy Hospitals in the Neurosurgery Department from January 2021 to June 2021.

Inclusion criteria: Single level lumbar spine spondylolisthesis

Exclusion criteria: Morbidly obese patient with weight record more than 35. Age under 14y old. Post traumatic patient. Recurrent Cases.

Primary outcome: Analysis of the clinical result (Pain and functional scores)

Secondary outcome: Assessment and disappointment rates and long term complications. Analysis of the radiological findings.

The cases of study were subjected to:

Prior to patient admission, full clinical history is investigated for all participants and full clinical assessment is done to survey in case there's an immediate sign for a medical procedure, if not patients should be exposed to moderate administration, for example, (clinical therapy, physiotherapy and bed rest) for 4 to 6 weeks if these actions failed, The patient is considered surgical and things from the patient's outline will be utilized to distinguish possible members for recruitment include: Name, date of birth, sex, determination, presence of other lumbar pathologies.

Clinical and Radiological assessment was done to evaluate neurological status of the patient and Oswestry disability index and VAS score to compare it with post operative results.

The Oswestry Disability Index (ODI) is a file gotten from the Oswestry Low Back Pain Questionnaire utilized to evaluate handicap for low back pain self finished survey includes ten items concerning severity of pain, lifting, ability to really focus on oneself, ability to walk, ability to sit, sexual capacity, ability to stand, public activity, rest quality, and capacity to travel. Every point classification is followed by 6 statements describing different potential scenarios in the patient's life relating to the topic. The participant then, at that point, checks the explanation which most intently takes after their circumstance. Each question is scored on a scale of 0-5 with the principal statement being zero and demonstrating minimal measure of incapacity and the last assertion is scored 5 showing most extreme inability. The scores for all questions answered are added, then, at that point, increased by two to get the list (range 0 to 100). Zero and 100 are likened with absence of handicap and the extreme incapacity, respectively.

Scoring (%):

- 0–20: Least handicap
- 21–40: Moderate inability
- 41–60: Severe inability
- 61–80: Crippling pain
- 81–100: Patients have symptoms' exacerbation or are bed-bound [8].

The Visual Analog Score (VAS) is a psychometric reaction scale that is utilized in questionnaires. It is an estimation tool for emotional attributes or mentalities that can't be straightforwardly estimated. When reacting to a VAS thing, respondents determine their degree of consent to a statement by demonstrating a situation along a consistent line between two end-points [9].

Radiological evaluation as X-ray dynamic view and MRI LSS.

Surgery:

The patient was put on a radiolucent operating table in a prone posture while under general anesthesia. A C-arm machine was used to identify the affected segments, which were subsequently marked on the patient's skin. A skin incision made in the middle and dissected through both sides. Sacrospinalis split and subperiosteal muscle separation reveal the facet joint, transverse processes, and vertebral lamina. Until the dural sac and both nerve roots were completely decompressed, BPSs were placed and the ligamentum flavum, ventral side of the lamina, and medial parts of both facet joints were adequately decompressed. A PEEK cage filled with

autologous bone was inserted into the center of the disc space after a complete discectomy and sequential distraction and preparation of the intervertebral space. Eventually, the incision was closed according to protocol and a drain was inserted.

Outcome assessment:

Pain and functional outcome were measured by VAS and ODI. Complications were recorded and

cases were demanded to return for follow-up at 3 months. Radiographic assessment involved failure of screw/rod, cage migration. Cage migration was defined as posterior cage displacement greater than 3mm in comparison to the immediate postoperative condition.

Results

Table (1): Age & BMI of cases.

	Mean	Median	Min	Max	SD	Percentile 25	Percentile 75
Age	46	45	26	58	9	41	53
BMI	28.1	28.4	22.1	34.1	3.3	25.9	30.4

Table (2): Gender differences of cases.

Sex	Number	%	Level	Frequency	Percent
Men	7	30.4	<i>Valid:</i>		
Women	16	69.6	L5/S1	1	4.3
			L4/5	19	82.6
			L3/4	3	13.0
Overall	23	100.0	Total	23	100

Table (3): Levels of spondylolisthesis.

Table (4): Clinical presentation of cases.

Back Pain	Frequency	Percent
<i>Valid:</i>		
Yes	23	100.0
Claudication		
<i>Valid:</i>		
Yes	20	87.0
No	3	13.0
Overall	23	100.0
Sciatica		
<i>Valid:</i>		
Yes	16	69.6
No	7	30.4
Overall	23	100.0

Table (5): Detailed comparison between complications of cases.

Complications	Frequency	Percent
<i>Valid:</i>		
Dural tear	1	4.3
Infection	2	8.7
System failure (broken screw or rod)	1	4.3
Cage migration	1	4.3
No complications	18	78.3
Total	23	100.0

Table (6): Low back pain VAS outcome of cases.

	Mean	Median	Min	Max	SD	Percentile 25	Percentile 75
LBP VAS (pre)	7	7	5	9	1	6	8
LBP VAS (post)	4	4	3	5	1	3	5
LBP VAS (3m)	3	2	1	5	1	2	3

Table (7): Comparison between LBP VAS pre- and post-operative & at 3 months post operative.

	Mean	N	SD	p
<i>Pair 1:</i>				
LBP VAS (pre)	7.13	23	1.180	<0.001*
LBP VAS (post)	4.17	23	.834	
<i>Pair 2:</i>				
LBP VAS (pre)	7.13	23	1.180	<0.001*
LBP VAS (3m)	2.61	23	1.033	
<i>Pair 3:</i>				
LBP VAS (post)	4.17	23	.834	<0.001*
LBP VAS (3m)	2.61	23	1.033	

Table (8): Lower Limb pain VAS outcome of cases.

	Mean	Median	Min	Max	SD	Percentile 25	Percentile 75
Lower extremity (pre)	7	7	5	9	1	7	8
Lower extremity (post)	3	3	2	5	1	2	3
Lower extremity (3m)	2	2	1	4	1	2	3

Table (9): Comparison between LLP VAS pre-operative, post-operative & at 3 months post operative.

	Mean	N	SD	p
<i>Pair 1:</i>				
Lower Limb Pain VAS (pre)	7.26	23	.915	<0.001*
Lower Limb Pain VAS (post)	2.83	23	.834	
<i>Pair 2:</i>				
Lower Limb Pain VAS (pre)	7.26	23	.915	<0.001*
Lower Limb Pain VAS (3m)	2.39	23	.656	
<i>Pair 3:</i>				
Lower Limb Pain VAS (post)	2.83	23	.834	0.076
Lower Limb Pain VAS (3m)	2.39	23	.656	

Table (10): Functional score “Oswestry’s disability index of cases.

	Mean	Median	Min	Max	SD	Percentile 25	Percentile 75
Oswestry Score (pre)	48	49	38	56	5	44	52
Oswestry Score (post)	18	18	14	24	2	17	20

Table (11): Comparison between Oswestry’s disability index of cases assessed pre-operative and after 3 months post operative.

	Mean	N	SD	p
<i>Pair 1:</i>				
Oswestry Score (pre)	48.00	23	5.469	<0.001*
Oswestry Score (post)	18.35	23	2.386	

Discussion

Variable careful procedures with and without instrumental fixation are generally proposed to manage distinctive spinal pathologies. Many authors suggested anterior approaches however, the post approaches have acquired prominence among spine specialists with good outcomes and less complications as contrasted and anterior approaches. Post lumbar fusion (PLF), Posterior lumbar interbody fusion (PLIF) and TLIF are much of the time used to alleviate agony and nerve pressure in individuals with degenerative disc is order, lumbar canal stenosis spondylolisthesis, scoliosis failed back operation and injuries [10,11,12].

TLIF uses a posterior strategy to deal with the spine that goes through the vertebral foramen far lat portion gets to the disc space, which gives the specialist a combination strategy that might diminish large numbers of the dangers related with PLIF, yet creates comparable stability. Hence, it was displayed to decrease the occurrence of postsurgical radiculitis [13,14].

Subsequently, TLIF has a proficient circumferential arthrodesis via single entry with the lowest risk of dural and neural injury. Simultaneously, it permits back and foraminal decompression. Hence, this method should be advanced and appropriately utilized in chosen subjects, particularly when back decompression and circumferential interbody combination of the lumbar region are essential [15].

Our review is a cross sectional analytic study expecting to investigate clinical, functional and radiological result of individuals treated with TLIF.

Patient's demographics:

In our review the mean age was 46; while in comparative investigations as Xue H., et al., the mean age was a much higher (58.2) and was (62.2 years) in Dahdaleh, N. S. et al. [16,17].

As regarding to gender we had atotal of 7 male patients (30.4%) and atotal of 16 female patients (69.6%) with female gender predominance; different investigations like Dahdaleh, N. S. et al., show also female predominance yet with various percentile where male patients were 30% just, In Duncan, J.W. et al., male patients were (36%) and 36 female patients (64%) [16,18].

Albeit the prevalence of female sexual orientation, we didn't track down a sex inclination for disappointment or difficulties in such manner.

The review was conducted on 23 patients with BMI going from 22.1 to 34.1 with mean BMI 28.1 Divided into 3 groups 4 patients in ordinary reach (17.4%), 13 patients are overweight (56.5%) and 6 are obese (26.1%).

While in Wang, Jian; Zhou. The mean BMI was where 28.3kg/m^2 . More than 33% of the patients (37%) were obese.

While in Lau, Darryl; Khan 127 patients met the review's criteria with a BMI of essentially 30.0 and who had gone through a solitary TLIF level. 61, 45 and 21 cases had Class I, II and III obesity, respectively [19,20].

The pathology and the levels:

L4/5 was the most widely recognized level associated with 19 individuals (82.6%) that is essentially due to the prevalence of degenerative sort of spondylolisthesis in our review, L3/4 was involved in 2 cases (13%) and L5/S1 was involved with asingle patient (4.3%); Other studies showed different findings for example Shen, X. et al., showed higher affection of L5/S1 level over L4/5 level with 19 cases influencing L5/S1 and 15 cases influencing L4/5; On the other hand Dahdaleh, N. S. et al., study showed different distribution of affected levels as follows: L4/5 was affected in 60%, L5/S1 comes next with 35% affection and L3/4 affection was 5% [16,21].

Our review focused on a single level spondylolisthesis of our subjects where 9 patient with lytic spondylolisthesis 9 (39.1%) and 14 patient with degenerative spondylolisthesis (60.9%); in correlation with different investigations where various lumbar pathologies were involved for instance Duncan, J. W., et al., study consisted mainly of herniated disc disease with or without herniated discs (80%), spinal stenosis as well as foraminal stenosis related with unsteadiness (14%) and degenerative spondylolisthesis in (6%); Liang, Y., et al., concentrate likewise showed avariety of lumbar spine pathologies as Discogenic low back pain (31 instances of 119) – 26%, Recurrent disc herniation 10 cases (8.5%), Lumbar spine stenosis (29%) and 44 Lumbar Spondylosis case (37%) that can result in difference in result clinically or in rate of complication; Xue H., et al., demonstrated avariety of diagnosis as follows: 15 cases (19%) of Spinal stenosis with spondylolisthesis, 19 cases (24%) of spondylolisthesis without critical stenosis, 7 cases (9%) of Huge lumbar disc herniation, 9 cases (11%) of Unilateral disc herniation, 15 cases (19%) of Discogenic low back pain and 17 cases (21%) of intermittent lumbar disc herniation [17,18,22].

Complications:

Intraoperative and post-operative complications were seen in a time of 90 days and a statistical finding was noted.

Where Cage migration is found in a single patient (4.3%). In Duncan, J.W., et al., study; the cage migration was 11%; And in Ren, C., et al., cage rate of migration was likewise higher; while Liang, Y.,

et al., revealed a lower rate of migration (5.9%) [18,23,24].

Dural tear happened in 1 case; In Shen, X., et al., concentrate on 1 case also (3%) had dural tear.

Wound infection (superficial) reported in 2 subjects (8.7%); in other studies like Xue H., et al., concentrate on 2 cases show disease (6%).

Additionally, our review shows 1 case (4.3%) with system failure of a broken screws following 3 months; In Xue H., et al., concentrate on 1 case (3%) show system failure [17,21].

In Humphreys et al., similar concentrate among PLIF and TLIF subjects. No complication was reported in TLIF patients. Be that as it may, regarding PLIF, there were 4 radiculitis cases, 1 broken equipment patient, 1 screw loosening subject, 2 screw removal cases, 1 case with superficial wound infection and another one with nonunion requiring more fusion [25].

The authors deduced that the TLIF was a good option in contrast to PLIF with a relatively fewer complications.

Clinical outcome:

Concerning low back pain which was determined by VAS pre-operatively, post-operatively and at 90 days follow-up in our review; results were as follows:

Mean pre and postsurgical VAS for LBP was 7 and 4, respectively, whereas at 3 months it was 3; Xue H., et al found a normal of 8.5 versus 2.8 after 6 months; this can be because of variabilities of Lumbar pathologies which was operated upon in different studies while our review focused on spondylolisthesis which shows higher difficulty rates and therefore more worse low back pain VAS on follow up; Shen, X., et al., concentrate additionally displayed no huge distinction between VAS of pre-usable and follow-up of low back pain as follows; pre-operative VAS showed a normal 7.2 pre-usable score, 2.3 at 90 days and 2.2 at a year [17,21].

Regarding lower limb pain VAS in our study; Mean VAS presurgically for LLP was 7, Mean post-operative VAS was 3, follow-up at 3 months yield a mean 2; Dahdaleh, N. S., et al., reported Pre-operative VAS averaged 5.8 and their post-operative VAS averaged 2.1 [16].

In Yan et al. 2008, pain index improved in PLIF group from 7.08 ± 1.13 to 2.84 ± 0.89 and in TLIF from 7.18 ± 1.09 to 2.84 ± 0.91 . There were 42 and 29 cases of excellent and good outcomes, respectively in PLIF category, whereas in TLIF category they were 46 and 31 cases respectively showing that in this review both approaches were good for the spondylolisthesis with no considerable variance and

revealed that Interbody fusion with either a PLIF method or a TLIF strategy gives great results in the management of adult degenerative spondylolisthesis. The TLIF method easier and is pretty much as protected and viable as the PLIF procedure. This review exhibits that the TLIF method offers a valuable option to the more conventional PLIF technique Eur Spine J (2008) [2].

Functional outcome:

The Oswestry's inability index (ODI) mean pre-operatively was 48 and at follow-up was 18. Different research reported comparable findings such as Dahdaleh, N. S., et al with mean pre- and postoperative ODI of 39.2 and 17.9, respectively [18].

Radiological Outcome:

With respect to finding:

Radiological finding of complications; Cage migration was viewed as in single patient (4.3%); In Duncan, J.W., et al., study; the migration rate was 11%; In Ren, C., et al., the rate of cage migration was also greater; while Liang, Y., et al., reported much lower rate (5.9%) [18,22,23,24].

Furthermore, Our review shows 1 case (4.3%) with system failure with a broken bar following 3 months; In Xue H., et al., concentrate on 1 case (3%) show framework failure [17,21].

In Humphreys et al., near concentrate among PLIF and TLIF Cases. TLIF cases exhibited no complications. However, in PLIF subjects, there was 1, 1, and 2 cases of broken, loosening and removal of screws, respectively and 1 nonunion need extra fusion [25].

With respect to rates; In our review fusion rates couldn't be assessed because of the shortage of time for follow-up. As most cases need longer time of follow-up for a considerable length of time as long as 1 year to have the option to evaluate fusion.

In this way, we are expecting to follow-up our review cases for longer period to have the option to follow fusion.

In different studies like In Xue H., et al., the fusion rate was 97% [17].

In Levin, Jay M.; Tanenbaum, Joseph E.; Steinmetz, Michael P.; Mroz, Thomas E.; Overley, Samuel C. (2018). Systemic review and meta-analysis study between TLIF and PLF.

The pooled fusion success rates were 84.7% (100/118) in the PLIF group and 94.3% (116/123) in the TLIF group.

Conclusion:

Each approach has its own risks and benefits with some similarities. Although this study is limited in frequency of cases and time of follow up,

it still shows an initial good experience with TLIF. In our study, it shows good clinical and functional outcome regarding VAS score and Oswestry's disability index, but it shows higher rates of complication and delayed fusion rates in comparison to other studies confined with TLIF. Despite limitation of cases and shortage of time of follow up might affect the result and outcome, human and technical errors may also contribute in that results; as it still a well promising technique in our country that needs more and more practice. Hence, this modality should be boosted and properly applied in selected patients, and its usage should be enhanced to be performed by spine surgeon. In general, regarding our study and other studies concerned with TLIF and other fusion techniques; We have concluded that fixation with TLIF showed better outcome clinically, radiologically and functionally with lower rates of complication in comparison with other fusion techniques. Serial imaging and Long-term clinical follow-up are recommended with wider range of lumbar pathologies for better assessment of the efficiency and safety of TLIF.

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نظرة عامة على النتائج الإكلينيكية والفحوصات الإشعاعية لإلتحام الفقرات القطنية باستخدام دعامة من خلال ممر عظمى لفقرات العمود الفقري القطنى

تثبيت الفقرات القطنية كان لاعوام كثيرة العلاج الامثل لعلاج الام الظهر السفلية الناتجة عن (تنكس القرص الغضروفى بين الفقرات، جراحات الغضاريف الغير ناجحة، الانزلاق الغضروفى) التى لم تستجيب للعلاج التحفظى والدوائى، وبالمشاركة مع جراحات ضيق القنوات الشوكية التى تحتاج إلى توسيع للقناة الشوكية.

العديد من الطرق الجراحية المختلفة قد برزت فى الفترة السابقة، ولكن حتى الان لا يوجد بيانات واضحة تؤكد افضلية احدى الجراحات عن مثيلاتها وهذا يرجع إلى ان لكل طريقة من طرق تثبيت العمود الفقرى مايميزها عن مثيلاتها وما تحمله من مخاطر ومضاعفات مع بعض التشابهات بين مختلف طرق التثبيت.

بعد موافقة اللجنة الاخلاقية لقسم جراحة المخ والاعصاب، قمنا بمراجعة مستقبلية لجميع المرضى الذين يعانون من انزلاق الفقاري القطنى احادى المستوى المعالج جراحياً فى الفترة بين يناير ٢٠٢١ و يونيو ٢٠٢١ فى مستشفيات جامعة القاهرة. بما يتضمن التركيبة السكانية للمريض، مستوى العمود الفقرى القطنى المتأثر ونوع الانزلاق الفقارى، العرض السريرى، معدل المضاعفات، النتائج السريرية (الام اسفل الظهر والام الاطراف السفلية) قبل الجراحة وبعدها مباشرة وبعد ٣ اشهر والنتائج الوظيفية والاشعاعية.

ومن خلال الدراسة التى قمنا بها بتثبيت اجسام الفقرات القطنية باستخدام دعامة من خلال ممر عظمى كان من الملاحظ تحسن اغلب الحالات سريريا ولكن مع ملاحظة ارتفاع فى نسب المضاعفات بالمقارنة بالدراسات الاخرى التى تتناول هذا الموضوع.

قلة عدد الحالات تحت الدراسة وضيق وقت المتابعة السريرية والاشعاعية قد يكون له تأثير على نتائج الدراسة، ولكن ايضا الاخطاء التقنية قد يكون لها دور كونه مازال اجراء جراحيا واعدا يحتاج إلى الاستمرارية وتحفيز جراحى العمود الفقري على استخدامه.

ولكن فى نهاية الدراسة ويتناول الدراسات الاخرى نستطيع ان نتبين ان التحام اجسام الفقرات القطنية باستخدام دعامة من خلال ممر عظمى كاجراء جراحى له نتائج سريرية واشعاعية ووظيفية واعدة وبمعدل مضاعفات واثار جانبية اقل بالمقارنة مع جراحات التثبيت الاخرى.