

Transforaminal lumbar interbody fusion (TLIF) in patients with lumbar instability submitted to transpedicular screws fixation

Moawed F. Eladawy, Samir M. El Ghandour, Ahmed Abdelaty

Department of Orthopaedic Surgery, Suez Canal University, Ismailia, Egypt.

The Egyptian Orthopedic Journal; 2018 supplement (2), December, 54: 9-17

Abstract

Purpose

This study is conducted to evaluate the clinical and radiological outcomes of Transforaminal lumbar interbody fusion (TLIF), with pedicular screws fixation, in the treatment of patients with lumbar instability.

Patients and Methods

A prospective study of 20 patients with lumbar instability treated with transforaminal lumbar interbody fusion (TLIF) technique. All patients have been operated upon with such technique of fusion with one cage (carbon fiber) and pedicular screws fixation. We included patients between 18-65 years, without previous lumbar surgery, grades 1 and 2 spondylolisthesis. Patients with previous lumbar surgery or with higher grades of spondylolisthesis were excluded. Visual Analogue Scale (VAS) for pain and Oswestry Disability Index (ODI) were used to assess the patients pre-operative and at post-operative intervals at 1, 3, 6 months till two year duration. Pre-operative and post-operative radiographs were done using static and dynamic X-rays, computerized tomography, and magnetic resonance imaging.

Results

Patients were assessed for severity of low back pain in a percentage value by VAS score pre-operatively, after surgery by 48 hours, one month, three months, and six months until two year. The maximal score pre-operative was nine and minimal was six with a mean of 7.7 (± 0.864), While six months till two year postoperatively, the maximal score was 6 and minimal was 1 with a mean of 2.2 (± 1.76). Regarding the percentage of pre-operative severity of pain, 9 patients (45%), suffered from moderate pain while 11 patients (55%) had severe pain. After one year follow up the percentage changed to 85% with mild pain and only 15 % with moderate one respectively with nearly same results after two years. The ODI maximal score pre-operative was 80 and minimal was 40. While from six months till two year duration postoperatively, the maximal score was 35 and minimal was 10 with statistical significance. While radiologically, 17 patients, (85%) have showed good fusion results while the rest 3 patients, (15%) have showed delayed or no signs of fusion.

Conclusion

TLIF provides good clinical and radiological outcomes in management of lumbar instability after follow-up period of two year duration. Operative complications are less in TLIF technique, and risk of dural tear is diminished significantly. TLIF can save much operative time and blood loss.

Key Words

Spondylolisthesis, lumbar, fusion, transforaminal.

Introduction

Spinal fusion, also known as spondylodesis or spondylosyndesis, is a surgical technique used to combine two or more vertebrae. Supplementary bone tissue (either autograft, allograft or sometimes bone substitutes) is used in conjunction with the body's natural osteoblastic processes. This procedure is used primarily to eliminate the pain caused by abnormal motion of the vertebrae by immobilizing the vertebrae

themselves [1]. Lumbar interbody fusion is a recognized surgical technique which was introduced approximately 70 years ago and has evolved as a treatment option for symptomatic spinal instability, spinal stenosis, spondylolisthesis, and degenerative scoliosis [2]. The aim is the production of a bony fusion between 2 vertebral bodies, decompression of neural structures, reconstitution of disc space height, and restoration of sagittal plane alignment [3]. Besides,

the main goals of spinal fusion of the lumbar spine, is obtaining a primary solid arthrodesis so as to alleviate pain[4-5-6]. Different circumferential or “360_” fusion techniques have been described such as combined anterior–posterior fusion (APF), instrumented posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF) [7]. However there are two main types of posterior lumbar spinal fusions, which may be used separately or in conjunction with each other; Posterolateral fusion and Interbody fusion [4]. Interbody fusion involves radical disc removal and replacement with bone graft. It is a well-established method of spine stabilization that can be performed through an anterior or posterior approach [8]. There are three types of interbody fusion: firstly anterior lumbar interbody fusion (ALIF) - the disc is accessed from an anterior abdominal incision, Secondly posterior lumbar interbody fusion (PLIF) - the disc is accessed from a posterior incision and finally transforaminal lumbar interbody fusion (TLIF) - the disc is accessed from a posterior approach through one of facet joint [4]. In patients with evidence of spinal instability and lumbar canal stenosis, posterior lumbar fusion is recommended as a treatment option in addition to decompression for stenosis of the spinal cord [9].

The PLIF procedure was first described by Briggs and Milligan in 1944 [10] who used laminectomy bone chips in the disc space as interbody graft. In 1953 Cloward [11] described his technique, which used impacted blocks of iliac crest autograft in disc space. In the 1990s, at which time the advent of preformed supplementary interbody implants and instruments with which to insert them increased the technical ease and subsequent popularity of this technique[12]. Structural implants, such as synthetic cages or allografts, have now become a standard part of PLIF to support and stabilize the disc space until bone graft unites the bone of the opposing vertebral endplates[13]. Interbody cages have become popular and are now composed of a wide range of materials, such as titanium mesh, carbon fibers, and polyether ether ketone or the so called (PEEK)[14].

Posterior lumbar interbody fusion requires retraction of the thecal sac and nerve roots to gain sufficient access to the posterior disc space through the spinal canal. This increases the risks of incidental durotomy and injury to the nerve roots or conus medullaris if above L2–3. It also leads to postoperative scarring of neural tissue due to side retraction[15]. In 1982, Harms and Rolinger [16] reported use of bone graft packed in a titanium mesh that was inserted via a transforaminal route into the disc space. Termed “transforaminal lumbar interbody fusion” (TLIF), their technique relied on distracting the motion segment through pedicle screws that were placed before

cage insertion, and it could be accomplished without exposing more than the ipsilateral foramen. By removing the entire facet joint, it minimizes retraction on the thecal sac, decreasing the risk for a durotomy and limiting possible neurological injury. TLIF enables placement of the graft within the anterior or middle aspect of the disc space to restore lumbar lordosis. Finally, because the contralateral laminae and spinous processes can be preserved, additional surface area is available to help achieve a posterior fusion. The advent of interbody devices and posterior screw-rod fixation has lowered the rate of pseudarthrosis associated with TLIF procedures[17]. Consequently; the indications for these surgical procedures have broadened. The principal indication for lumbar interbody fusion surgery using TLIF technique is the stabilization and fusion of adult spinal deformity. Therefore, lumbar fusion with such technique, has been described as a treatment of symptomatic spondylolisthesis, degenerative scoliosis and spinal stenosis associated with instability, Secondary indications include recurrent lumbar disc herniation, where extensive bony removal is necessary for exposure of the disc fragments, lateral or massive disc herniations, failed previous lumbar fusions by other techniques, and discogenic low back pain[18].

Since Cloward’s, 1985[19] original descriptions, numerous modifications of the PLIF and subsequent TLIF techniques have been reported to improve the surgical ease along with the arthrodesis rates[20-21]. These circumferential interbody fusion techniques specially TLIF technique, have some distinct theoretical advantages over other posterolateral techniques. First, the TLIF procedure is more biomechanically sound because with such technique, the bone graft is placed along the weight bearing axis of the spine. The graft is therefore under maximal compression with both the anterior and posterior columns under tension[2]. An increased arthrodesis rate over historical controls is facilitated by a wider area of intervertebral bone-to-graft contact. This improves blood supply to the graft from the rich cancellous portion of the vertebral centrum[22]. Such procedures allow complete decompression of the neural foramen and nerve roots, restoration of intervertebral height, and near-total discectomy and restoration of segmental lordosis at the fused level [23]. Although the popularity of posterior lumbar fusion techniques continues to increase, there are few published studies emphasizing the clinical outcome or fusion rates attained by TLIF technique. This study is one of the ongoing efforts to evaluate the clinical and radiological outcomes of transforaminal interbody fusion in patients with lumbar instability submitted to transpedicular screws fixation.

Patients and Methods

In the period between 2013 and 2015 the first 20 patients had symptoms of spinal instability and indicated for lumbar spinal fixation and fusion were included in this prospective study.

Inclusion criteria: Age between 18-65 years, both sexes were accepted, patients had first time lumbar surgery, single or double level lumbar spine instability, all lumbar levels were included (L1- L2), (L2-L3), (L3-L4), (L4-L5) and (L5-S1), all types of spondylolisthesis with grade 1 or 2, lumbar spinal canal stenosis with instability and black disc disease.

Exclusion criteria:

Patients had marked neuro-logical deficits (sphincter abnormality), patients with morbid obesity measured by BMI >40, high grade spondylolisthesis, grade 3 or 4, lesions involved more than two levels and previous lumbar surgery.

Pre-operative assessment:

History and examination: Data included; sex, age, occupation, smoking and co-morbid medical conditions, past history of chronic illness as; diabetes mellitus, hypertension, neurological complaint, previous trauma or operations. Data concerning the presence of back pain, radicular pain and its dermatome distribution, parasthesia, motor weakness, sphincter and sexual dysfunction was recorded.

Measurement scales of the clinical outcome:

Back pain and radicular pain were assessed using a visual analogue scale where patients were selected by a value between pain free (VAS 0) and unbearable pain (VAS 100)[24]. Preoperative and postoperative economic (activity) and functional (pain) statuses was assessed and classified according to Oswestry disability index ODI[25-26]. After completing the questionnaire the disability was classified into: Minimal disability ODI = 0-20%, moderate dis-ability ODI = 21%-40%, severe disability ODI = 41%-60%, crippled ODI = 61%-80% and ODI = 81%-100% means that these patients are either bed-bound or exaggerating their symptoms.

Preoperative radiological assessment:

The preoperative radiographic evaluation consisted of: Routine static and dynamic plain lumbosacral spine X-ray lateral view to assess the spine for presence of preoperative instability, and anatomical variants. C.T. lumbosacral spine for all patients to measure canal diameter at the stenotic level, pedicle di-

ameter and fracture pars interarticularis. MRI lumbosacral spine for all patients with accompanying symptoms of neural compression.

TLIF technique:

1. Patients were placed prone on a surgical table.
2. Surgical exposure:

Landmarks for Skin Incision:The landmarks for the posterior approach are:spinous processes, posterior superior iliac spine and iliac wings.

The line drawn between the bilateral posterior superior iliac spine usually projects to the disc level of L4-L5.

Superficial Surgical Dissection:

After the incision of the skin in the midline above the spinous processes and the dissection of the subcutaneous layers, the lumbosacral fascia was incised with a cautery knife. The paraspinal musculature was subperiosteally detached from the spinous process and the laminae. Sponges are used to push the paraspinal muscles laterally and control bleeding by densely packing the created space between the spinous process and the muscle. Care had been taken not to injure facet joint capsules.

Deep Surgical Dissection:

The posterolateral bed was prepared for the bone graft. Therefore, the multifidus muscle was detached from the laminae, facet joint and transverse process. While dissecting the transverse process, the periarticular vessels which cross around the facet joint and transverse process usually tend to bleed and need to be controlled by electrocautery. The retractors should be released intermittently Depending on the clinical presentation, a laminectomy, facetectomy, or both was performed. A unilateral laminotomy and partial facetectomy are performed on the side consistent with the patient's symptoms or anatomical abnormalities. Depending on the need for medial exposure, a medial facetectomy is usually sufficient for exposure, although in those cases not requiring a medial decompression, exposure was obtained by removing the lateral aspect of the inferior articular facet until the edge of the thecal sac comes into view. A bilateral laminectomy was reserved for clinically significant bilateral neural element compression as in bilateral fracture pars interarticularis. After adequate decompression of the neural elements had been performed, pedicle screws are placed in the standard fashion. The disc space was gradually distracted by using the pedicle screws. A complete discectomy was performed from one side using rongeurs, disc shavers,

and down-biting curved curettes. Anterior third of the disc space was filled with bone graft from the lamina, facet bone or iliac bone graft. A single "banana"-shaped carbon fiber cage (Medtronic Sofamore, Daneki, Memphis, TN) packed with bone graft was tamped into the disc space. Once the graft had been placed within the interbody space, pedicle screws are then attached to lordotic rod and carefully compressed to restore lumbar lordosis while maintaining the restored disc height. The contralateral facet joint and the remaining lamina sometimes were decorticated, and the bone graft is placed over them for posterolateral fusion. A standard closure in layers is performed [27].

Clinical follow-up:

Full neurological examination was performed for all patients after recovery and at 1, 3, and 6 months and till one year intervals. The VAS was assessed 48 hours post-operative and at 1, 3 and 6 months till one year intervals. The ODI was calculated post-operative at 1, 3 and 6 months and till one year intervals as well. We reported any post-operative complications including wound infection, CSF leakage, implant expulsion or implant removal.

Radiological follow-up:

One day post-operative static lumbosacral X-ray was done to evaluate the site of screw and the cage. In case of severe post-operative sciatica or progressive radiculopathy CT lumbosacral spine was requested for more evaluation of screws and graft. Six months and one year post-operative C.T. lumbosacral spine bone-window and 2D sagittal reconstructions was done for all cases to assess the fusion. The fusion was assessed by radiologist who was not aware with clinical data of the patients. Successful fusion was defined as: Presence of bilateral continuous trabecular bone bridging the interspace between the fused segments, nonunion is considered when there is a translucency, or absence of trabeculae in the interspace between the vertebral bodies and the graft.

Results

Patients of the study were matched as regard to age, sex, job and chronic medical conditions with no statistically significant difference. In the present study which contains one group of 20 patients including 8 females (40%) and 12 males (60%), their age ranges from 27 years old to 50 years with a mean of 40.3 (\pm 7.6) years. All female was non-smoker, while 10 males, (83.33%) were smokers & only two males, (16.67%) were non-smokers. All of the patients were

suffering from back pain. 9 patients (45%), were suffering from motor weakness and 11 patients (55%), were having sensory abnormalities, while reflexes were preserved in all of them. Pre-operative radiological diagnosis revealed, 12 patients (60%), were of the isthmic type while 8 patients (40%) were of the degenerative type, according to the level of affection, 2 patients (10%) had a single level lumbar pathology while the rest 18 patients (90%) had a double lumbar level type. According to the grade of spondylolysis, 5 patients (25%), had grade -1 spondylolysis while 15 patients (75%), had grade -2 spondylolysis. Laminectomy was done for all patients in the form of either hemi-laminectomy or total according to the indication of each case. All patients were submitted to trans-pedicular screw fixation. The screw fixation system used was all of the top-loading polyaxial type. The iliac bone grafting, it was done for 4 patients (20%), while facet and laminal bone grafting were done for the rest 16 patients (20%).

Operative time was assessed and a comparison between iliac bone graft group and lamina & facet group was done. The maximal time was 195 min. and minimal was 120 min. with mean of 153 min. (\pm 23.6) in lamina and facet group. While in iliac bone graft group the maximal time was 240 min. and minimal was 180 min. with mean of 207 min. (\pm 25) with a significant statistical difference between the two groups, blood loss was assessed and a comparison between iliac bone graft group and lamina & facet group was done. The maximal blood loss in lamina and facet group was 750 ml. and minimal was 200 ml. with a mean of 512.2 ml (\pm 170.7). While in iliac bone graft group the maximal blood loss was 900 ml. min and minimal was 700 ml. with a mean of 812.5 ml (\pm 85.93). The difference between two groups was statistically significant.

It was found that 13 patients (65%), were suffering from radiculopathy while 7 patients (35%), were not pre-operatively. Post-operatively after a whole one year of follow up, we found that one patient (5%), suffered from radiculopathy while 95% of patients were not. The difference between two groups was statistically significant (chart 1).

The percentage of sensory abnormality among the patients changed from 55%, 11 patients with abnormality, pre-operatively to 40%, 14 patients post-operatively with improvement of 3 patients after surgery. While the percentage of motor weakness among the patients changed from 45%, 9 patients with motor weakness, pre-operatively to 40%, 8 patients post-operatively, with improvement of only one patient after surgery.

The primary endpoint was to assess the effectiveness

of the TLIF technique by Oswestry disability index (ODI) and visual analogue scale (VAS) scoring system, post-operative fusion as well as satisfaction of patients with surgery. Patients were assessed for economic (activity) and functional (pain) statuses according to ODI. Pre-operatively, after surgery by one month, three months, six months and after one year.

The maximal score pre-operative was 80% and minimal was 40% with mean of 63 (± 13.8). While from six months till one year duration postoperatively, the maximal score was 35% and minimal was 10% with a mean of 16 (± 8.3) with a significant statistical difference (chart 2).

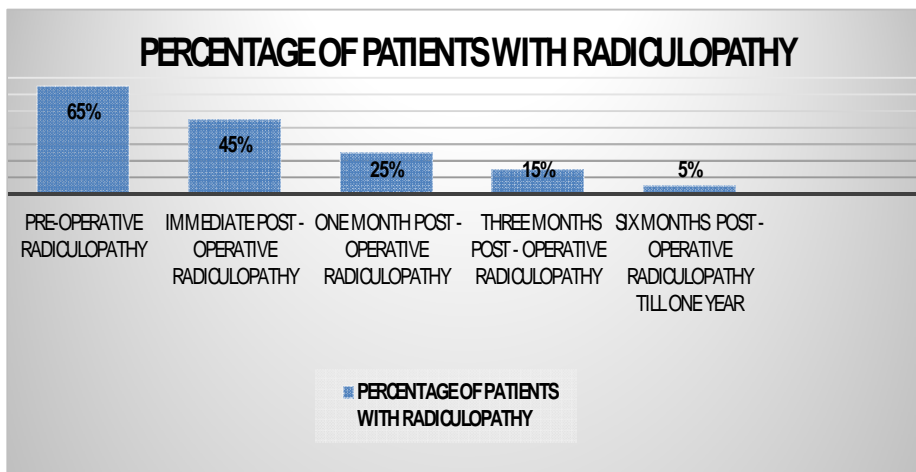


Chart 1: pre & post – operative percentage of radiculopathy among patients

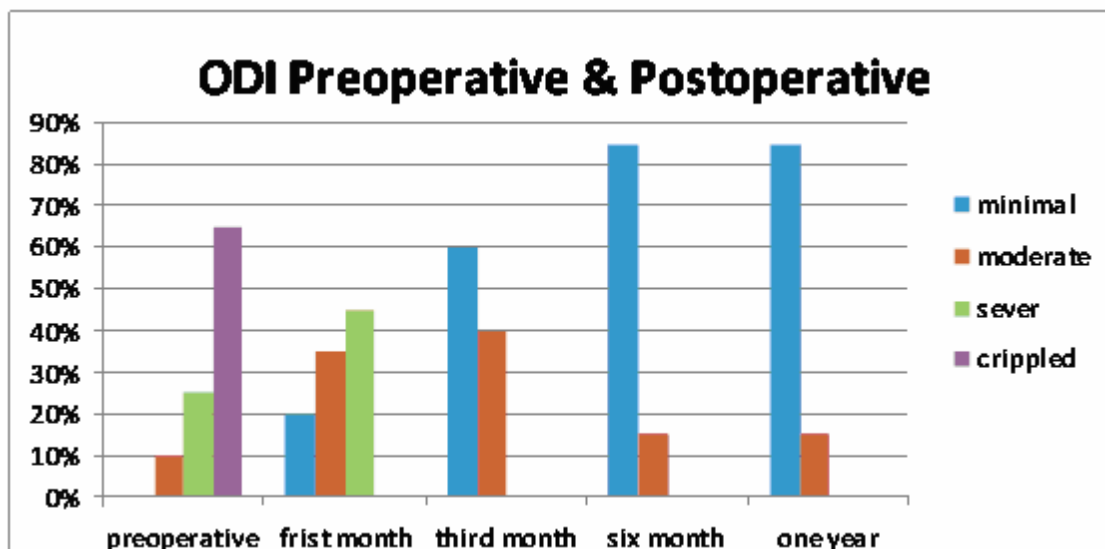


Chart 2: economic (activity) and functional (pain) statuses according to ODI

Patients were assessed for severity of low back pain in a percentage value by VAS score pre-operatively, after surgery by 48 hours, one month, three months, and six months till one year. The maximal score pre-operative was 9 and minimal was 6 with a mean of 7.7 (± 0.864), while six months till one year.

postoperatively, the maximal score was 6 and minimal was 1 with a mean of 2.2 (± 1.76). Regarding the pre-operative severity of pain, 9 patients (45%), suffered from moderate pain while 11 patients (55%) had severe pain. After one year follow up the percentage changed to 85% with mild pain and only 15% with moderate one respectively (chart 3).

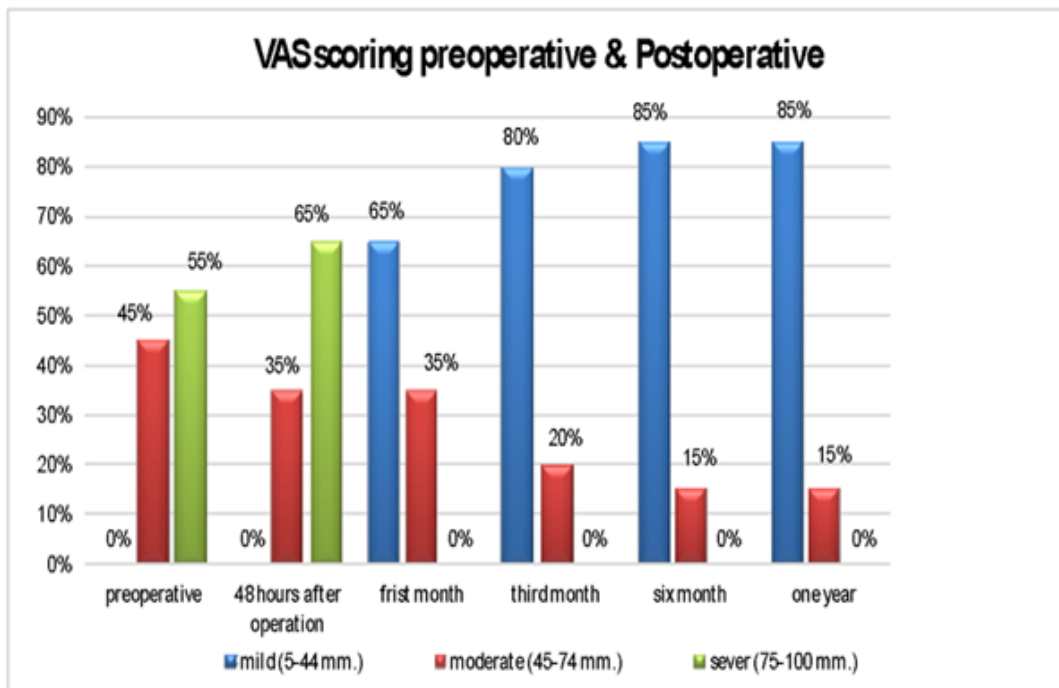


Chart 3: severity of pain according to VAS scoring system.

Preoperative, postoperative, and Follow-up radiologic data are summarized in Table-1.

Table 1: Follow-up radiologic data

	Pre-operative N=20	Post-operative N=20	P-value
Disc height (Mm)	9.5 ± 1.53	12.1 ± 1.28	<0.0001
Degree of listhesis (%)	19.7 ± 3.82	8.1 ± 2.44	0.04 No statistical significance
Segmental lordosis (degree)	15.8 ± 2.95	18.3 ± 1.86	<0.0001
Whole lumbar lordosis (degree)	51.2 ± 1.57	52.6 ± 1.65	No statistical significance

It was found that radiologic evidence of successful arthrodesis was noted in 17 patients (85%); fulfilled criteria D and E according to Brantigan et al. 1991 [43] radiological scoring system. While only 3 patients (15%) fulfilled only to the criteria B or C and showed delayed signs of fusion. The difference between two groups was significant.

Assessment of post-operative complications revealed that, only one patient 5% had dural tear and CSF leakage. While 2 patients only (10%) suffered from post-operative infection. Post-operative pain resulting from iliac bone grafting for those who had such type

of grafting, 50% of them suffering from pain for one week, 25% for one month & 25% for two months. 75% of patients were satisfied while 25% of patients were not satisfied. The difference between two groups was significant.

It was found that there were 75% of patients were satisfied while 25% of patients were not satisfied. The difference between two groups was significant.

Case:

50 years old female patient, housewife with a history of low back pain of 6 months duration. Clinical ex-

amination revealed left sided radicular pain of the lower limb with paresthesia along the anterolateral aspect of the leg and dorsum of the foot as well as weakness in the big toe. Reflexes are preserved with no history of incontinence. Plain x-rays revealed spondylolisthesis L5-S1 grade-1, MRI lumbosacral spine showed lumbar disc prolapse at level L5-S1 disc space, conservative treatment failed for 1 year duration. The patient was being operated upon using TLIF technique on the left side with hemi-

laminectomy and an operative duration of 120 min. and total blood loss of 400ml., The patient clinically improved; VAS decline from 80% to be 25 % after 6 months follow up and till one year duration and ODI improved from 60 % preoperatively to become 30 % after 6 months follow up and till a whole year duration. The patient was satisfied with good fusion obtained after 6 months of radiological assessment (Figure-1).

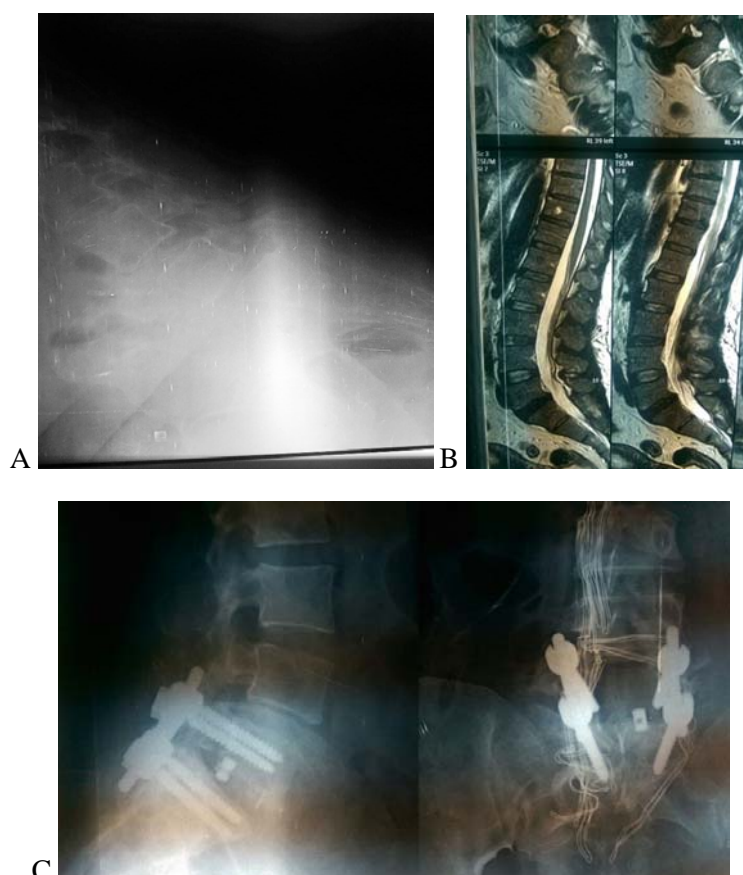


Figure-54:

- A) Plain x-ray lateral dynamic flexion view of lumbosacral spine showing spondylolisthesis L5-S1 grade-1
 B) MRI lumbosacral spine sagittal view showing spondylolisthesis L5-S1 grade-1 with disc bulge at level of L5- S1.
 C) Post-operative plain x-ray anterior-posterior and lateral views of the lumbosacral spine showing fixation by pedicular screws and cage insertion

Discussion

Concepts and techniques of spinal fusion as a therapeutic modality for pathologies of the spine date back to the origins of spinal surgery. Interbody fusion techniques have been developed to provide solid fixation of spinal segments while maintaining load-bearing capacity and proper disc height [28]. In 2001, the Swedish Lumbar Spine Study Group showed for the first time in a prospective and randomized study that lumbar fusion as a treatment of disabling low-back pain was significantly more effective than a con-

servative treatment regime [29]. In management of low back pain due to lumbar instability the main goal is to eliminate pain, decrease functional disability and with minimal complication [30]. So, in studying this technique we assessed clinical outcome regarding pain elimination, functional disability improvement and perioperative complication as well as the radiological outcome for such technique.

Operative maximal time was 195 min. and minimal was 120 min. with mean of 153 min. (± 23.6) in lamina & facet group. While in iliac bone graft group the

maximal time was 240 min. and minimal was 180 min. with mean of 207 min. (± 25) with a significant statistical difference between the two groups. The maximal blood loss in lamina & facet group was 750 ml. and minimal was 200 ml. with a mean of 512.2 ml (± 170.7). While in iliac bone graft group the maximal blood loss was 900 ml. min and minimal was 700 ml. with a mean of 812.5 ml (± 85.93). The difference between two groups was statistically significant. The difference between two groups is due to the separate incision for the iliac graft taking which requires more time with a resulting expected blood loss and possible postoperative complications. Immediate postoperative parasthesia in the form of numbness and tingling were recorded among all four patients which disappeared in all patients in a maximum time of two months. Results of Lars H. and coworkers [31] matched with our results, they found in assessment of TLIF technique in 52 patients that the operation time for one-level fusions averaged 173min (135- 220) and for multiple level fusions averaged 238 min (190-255). Results of Humphreys and coworkers [32] matched with our results; they compared 34 PLIF procedures with 40 TLIF procedures in respect of blood loss, operation time and complications. They found a significant differences in terms of these parameters for one-level fusions and less blood loss occurred in the TLIF when two-level procedures were compared. Lars H. and coworkers [31] in their study in TLIF evaluation found that blood loss of the one-level fusions averaged 485ml (220-860) and that of the multiple level fusions 560ml (430-1140).

The significant reduction in number of patients with radicular pain and parasthesia after surgery is for the virtue of minimal root retraction and no dural retraction in TLIF technique unlike for instance in PLIF, where there is frequent root manipulation and retraction of dura. Our results matched with good clinical outcomes over posterolateral fusion.

Interbody fusion techniques also appear to be the most effective treatment of discogenic back pain that is unresponsive to conservative measures. Some of the advantages of inter body fusion include immediate anterior column load sharing, a large surface area for fusion, bone graft subjected to compressive loads that is advantageous in achieving fusion, and the ability to restore normal sagittal contour while indirectly decompressing the neural foramen [33]. Weatherly et al. [34] reported on five patients during a 10-year period, who had "solid" posterolateral fusions but still had positive discography under the fusion and had their back pain relieved by anterior interbody fusions. Recently, Derby et al. [35] noted that patients with "highly sensitive discs" as determined by pressure-controlled discography achieved significantly better long-term outcomes with combined anterior/posterior

fusion than with inter- transverse fusion alone Humphreys SC. and coworkers [32] found that the post-operative radiculitis in TLIF group is lower than the post-operative radiculitis in PLIF group, while the same stability is provided for both groups.

There was significant reduction in VAS after the first month of follow-up which decreased more till the end of the 6 month post-operative. The maximal score pre-operative was 9 and minimal was 6 with a mean of 7.7 (± 0.864), While six months till one year postoperatively, the maximal score was 6 and minimal was 1 with a mean of 2.2 (± 1.76). Deng-lu Y. and coworkers found in their study that the pain index improved from 7.08 ± 1.13 to 2.84 ± 0.89 in PLIF patients and improved from 7.18 ± 1.09 to 2.84 ± 0.91 in TLIF patients [36].

Lars H. and coworkers assessed TLIF technique only and found that the VAS improvement is related to the pre-operative pathology. The VAS was in isthmic spondylolisthesis group 7.6 ± 2.3 and became after 3.4 ± 2.4 while in degenerative disorders group the VAS was preoperative 8.3 ± 2.6 and after 6 months post-operative it became 4.4 ± 2.216 [31].

In this study, ODI improved in progressive manner during the period of 6 months follow-up. The maximal score pre-operative was 80% and minimal was 40% with mean of 63 (± 13.8). While from six months till one year duration postoperatively, the maximal score was 35% and minimal was 10% with a mean of 16 (± 8.3) with a significant statistical difference. Lars H. and coworker found in their study in evaluation of TLIF technique that ODI decline in group 1 (patients with isthmic spondylolisthesis $n=22$) from 41.6 ± 21.7 to be 17.9 ± 14.2 after 6 months. In group 2 (patients with degenerative spondylolisthesis $n=30$) ODI was 58.4 ± 18.4 preoperative then improved to be 31.5 ± 20.5 after 6 months post operatively with no statistical significance [31]. Sebastian L. and his colleges assessed TLIF technique in 39 patients and ODI improved from 20.05 ± 7.9 preoperatively to become 10.95 ± 10.6 after 2 years of surgery [37].

75% of patients were satisfied while 25% of patients were not satisfied. The difference between two groups was significant. Benjamin K. in his study for 100 patients operated for TLIF found that the rates of patient satisfaction with the surgical procedure was 76% [38]. Madan and Boeree found satisfaction 69.5% in 23 patient treated with PLIF, while the satisfaction was 81% in 21 patients treated with posterolateral fusion technique [39].

Only one patient 5% had dural tear and CSF leakage, while 2 patients only (10%) suffered from post-operative infection. It is believed that the frequent dural sac retraction and the mandatory laminectomy increase the risk of dural tear and CSF leakage as for

instance in PLIF technique. In contrast, a TLIF technique need no retraction and laminectomy is not mandatory, so dural tear is less frequent.

Conclusion

TLIF provides good clinical outcome in management of lumbar instability after follow-up of one year duration. Operative complication is less in TLIF technique, and risk of dural tear is diminished significantly. TLIF can save time. TLIF costs is less, as we use only one banana shaped cage.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest

References

- Occupational Medicine Practice Guidelines (2 ed American College of Occupational and Environmental Medicine."Low Back Disorders. 2007; p. 210.
- Boos N, Marcheri D, Zuber K, et al. Treatment of severe spondylolisthesis by reduction and pedicular fixation: A 4–6 year follow up study. *Spine* 1993; 18:1655–61.
- Kwon KK, Scott B, Scott DD, et al. Radiographic analysis of transforaminal lumbar interbody fusion for the treatment of adult isthmic spondylolisthesis. *J Spinal Disord Tech* 2003; 16:469–476.
- Deyo RA, Nachemson A, Mirza SK Spinal-fusion surgery—the case for restraint *N Engl J Med* 2004;350:722–7265.
- Fairbank J, Frost H, Wilson-MacDonald J, Yu LM, Barker K, Collins R Randomized controlled trial to compare surgical stabilization of the lumbar spine with an intensive rehabilitation program for patients with chronic low back pain: the MRC spine stabilization trial. *BMJ* (2005). 330:1233.
- Rivero-Arias O, Campbell H, Gray A, Fairbank J, and Frost H, Wilson-MacDonald J surgical stabilization of the spine compared with a program of intensive rehabilitation for the management of patients with chronic low back pain: cost utility analysis based on a randomized controlled trial. *BMJ*2005; 330:1239.
- Jeszszky D the unilateral transforaminal approach for posterior lumbar interbody fusion. *Orthop Traumatol* 1998; 6:88–99.
- Daniel E., Chales L. and Branch JR., Posterior lumbar interbody fusion with bioabsorbable spacers and local autograft in a series of 27 patients. *Neurosurg.*2004; Focus 16 Article 8.
- Resnick DK, Choudhri TF, Dailey AT, et al. Guidelines for the performance of fusion procedures for degenerative disease of the lumbar spine. Part 9: fusion in patients with stenosis and spondylolisthesis. *J Neurosurg Spine.* 2005; 2:679–85.
- Briggs H, Milligan P. Chip fusion of the low back following exploration of the spinal canal. *J Bone Joint Surg.* 1994; 26:125–30.
- Cloward RB. The treatment of ruptured lumbar intervertebral discs by vertebral body fusion. I. Indications, operative technique, after care. *J Neurosurg.* 1953; 10:154–68.
- Turner JA, Ersek M, Herron L, et al. Patient outcomes after lumbar spinal fusions. *JAMA.* 1992; 268:907–11.
- Ray CD. Threaded titanium cages for lumbar interbody fusions. *Spine.* 1997; 22:667–79 (discussion79–80).
- Brantigan JW, Steffee AD, Geiger JM. A carbon fiber implant to aid interbody lumbar fusion. Mechanical testing. *Spine.* 1991; 16:S277–82.
- Chad D., Todd D., Meic H. et al. Comparison of low back fusion techniques: transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF) approaches. *Curr Rev Musculoskelet Med* 2009;2:118–126.
- Harms J, Rolinger H. A one-stager procedure in operative treatment of spondylolistheses: dorsal traction-reposition and anterior fusion (author's transl). *Z Orthop Ihre Grenzgeb.* 1982; 120: 343–7.
- Kim SS, Denis F, Lonstein JE, et al. Factors affecting fusion rate in adult spondylolisthesis. *Spine.* 1990; 15:979–84.
- Mummaneni PV, Haid RW, Rodts GE. Lumbar interbody fusion: state-of-the-art technical advances. Invited submission from the Joint Section Meeting on Disorders of the Spine and eripheral Nerves, March 2004. *J Neurosurg Spine.* 2004; 1:24–30.
- Cloward RB. Posterior lumbar interbody fusion updated. *Clin Orthop Relat Res.* 1985; 193:16–9.
- Grob D, Scheier HJ, Dvorak J, et al. Circumferential fusion of the lumbar and lumbosacral spine. *Arch Orthop Trauma Surg.* 1991; 111:20–5.
- Kozak JA, O'Brien JP. Simultaneous combined anterior and posterior fusion. An independent analysis of a treatment for the disabled low-back pain patient. *Spine.* 1990; 15:322–8.
- Khoo LT, Palmer S, Laich DT, et al. Minimally invasive percutaneous posterior lumbar interbody fusion. *Neurosurgery.* 2002; 51:S166–81.
- Branch CL Jr. The case for posterior lumbar interbody fusion. *Clin Neurosurg.* 1996; 43:252–67.
- Gillian A. Hawker, Samra Mian, Tetzana Kendyrska, and Melissa French *Arthritis Care & Research*2001; 63, No. S11, 240–S252
- Fairbank JC, Pynsent PB, "The Oswestry Disability Index." *Spine.* 2006;25(22):2940-2952.
- Inamdar D., Alagappan M., Shyam L., et al. Posterior lumbar interbody fusion versus intertransverse fusion in the treatment of lumbar spondylolisthesis. *Journal of Orthopaedic Surgery*2006; 14(1):21-6.
- Rosenberg WS, Mummaneni PV. Transforaminal lumbar interbody fusion: technique, complications, and early results. *Neurosurgery.* ;200148:569–75.
- Chao L, Hui-Ren W, Xi-Lei L, Xiao-Gang Z, Jian D . Minimally invasive versus open transforaminal lumbar interbody fusion: evaluating initial experience. *Eur Spine J* 2012;33(6):1683–1688.
- Fritzell P, Hagg O, Wessberg P, et al. Swedisch Lumbar Spine StudyGroup .2001 Volvo award winner in clinical studies: lumbar fusion versus nonsurgical treatment for chronic low back pain: a multicenter randomized controlled trail from the Swedish Lumbar Spine Study Group. *Spine* 2001; 26:2521– 2532.
- Martin Merkle, Beat Walchli, Norbert Boos. *Degenerative Lumbar Spondylosis. Spinal Disorders Fundamentals of Diagnosis and Treatment.* 1st edition Springer Chapter 2008;20, 552-571.
- Lars H, Henry H, Viola B, et al .Transforaminal lumbar interbody fusion: a safe technique with satisfactory three to five year results. *Eur Spine J.* 2005;14: 551–558.
- Humphreys SC, Hodges SD, Patwardhan AG, Eck JC, Murphy RB, Covington LA. Comparison of posterior and transforaminal approaches to lumbar interbody fusion. *Spine* 2001; 26:567-71.
- Lin P, Cautilli R, Joyce M. Posterior lumbar interbody fusion. *Clin Orthop* 1983; 180:154–67.
- Weatherley CR, Prickett CF, O'Brein JP. Discogenic pain persisting despite solid posterior fusion. *J Bone Joint Surg [Br]* 1986;68: 142–3.
- Derby R, Howard MW, Grant JM, et al. The ability of pressure controlled discography to predict surgical and nonsurgical outcomes. *Spine* 1999; 24:364–72).
- Deng-lu Y, Fu-xing P, Jian Li,et al .Comparative study of PILF and TLIF treatment in adult degenerative spondylolisthesis. *Eur Spine J.* 2008; 17:1311–1316.
- Sebastian L, Tobias L, Ulf L, et al. Clinical and Radiologic 2—4-Year Results of Transforaminal Lumbar Interbody Fusion in Degenerative and Isthmic Spondylolisthesis Grades 1 and 2 *Spine*2006; 31, Number 15, 1693–1698. 2006.
- Benjamin K. Potter, MD,Brett A. Freedman, MD, Transforaminal Lumbar Interbody Fusion Clinical and Radiographic Results, recurrences, failure rate and Complications in 100 Consecutive Patients, *J Spinal Disord Tech* 2007;18:337–346).
- Madan S, Boerere NR. Outcome of posterior lumbar interbody fusion versus posterolateral fusion for spondylolytics pondylolisthesis. *Spine*2002; 27:1536–42.