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Single space transforaminal lumbar interbody fusion in spondylolisthesis: initial experience of 30 cases

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Abstract

Spondylolisthesis in adults is characterized by the loss of disc height across the affected segment with sagital translation. The goal of stabilizing the spine is accomplished by fusion. Transforaminal approach for lumbar interbody fusion is a very good approach and reduces the complications associated with traditional posterior approach. It has been reported to be safe and effective in the treatment of spondylolisthesis. It has done to assess the functional outcome of Transforaminal Lumbar Interbody Fusion (TLIF) in spondylolisthesis. This prospective interventional study was performed from July 2008 to June 2011 included 30 patients (male 07, female 23), within a age range of 30-59 years. Nineteen cases were lytic, 08 cases were degenerative, 02 were post-traumatic and 01 dysplastic variety of spondylolisthesis. Follow up ranged from 12 to 24 months and outcome assessed by VAS and ODI regarding pain and disability. Achievement of fusion and complications were documented accordingly. Statistical analysis was done by unpaired t-test and chi-squared test in appropriate instances. We included twenty 0ne (70.00%) patient had Grade-II Spondylolisthesis and L_4 over L_5 had been the commonest level (53.33%) involved. Pain and disability improved significantly and 22 (73.33%) patients returned to their previous level of activity. One (03.33%) patient developed superficial wound infection and 01 (03.33%) had persistent low back pain. All patients had neurological improvement. We concluded that Transforaminal Lumbar Interbody Fusion is an effective alternative surgical procedure for the treatment of spondylolisthesis. Overall outcome is satisfactory in 93.33% cases.

Introduction

Spondylolisthesis is a common condition and is defined as the forward shift of the spinal column[1] which is characterized by a failure of the three-column support with severe complex instability requiring reconstruction[2]. The extent of the slip is usually graded using the Meyerding classification[3] in which the displacement of one vertebral body on another is divided into four equal parts. Grades I and II represent up to 25% and 50% displacement respectively and cover the majority of cases, are referred to as low-grade slips. The initial management of the condition is conservative. When this is deemed to have failed, surgery is considered. Surgery is indicated to prevent further progression of slip, to relief back and leg pain, reverse the neuro-deficit and stabilize the segment[4]. Posterolateral fusion has long been considered the "gold standard" for surgical treatment of adult spondylolisthesis. Superior results have subsequently been reported with interbody fusion with cages and posterior instrumentation[5].

Interbody fusion techniques have been developed to provide solid fixation of spinal segments while maintaining load-bearing capacity and proper disc height[6]. The ability to reconstruct the anterior column is important because 80% of the compressive, torsion, and shear forces are transmitted through the anterior column[7]. The two methods of achieving an interbody fusion from a posterior approach are Posterior Lumbar Interbody Fusion (PLIF) and Transforaminal Lumbar Interbody Fusion (TLIF)[8]. Since Harms and Rolinger[9] introduced transforaminal lumbar interbody fusion (TLIF), TLIF has been performed as an alternative to conventional posterior lumbar interbody fusion (PLIF)[10]. TLIF is an alternative interbody fusion procedure in which interbody space is accessed via the far lateral portion of the vertebral foramen[11]. It has several advantages over other fusion methods[12] and the clinical outcomes associated with TLIF have been reported to be comparable to those of PLIF or Anterior Lumbar Interbody Fusion (ALIF)[13] and has been reported to gain popularity world wide[14].

This technique is very new in Bangladesh and performing in our University and other private hospitals. We have performed this study with an aim to assess the outcome of TLIF in Spondylolisthetic cases.

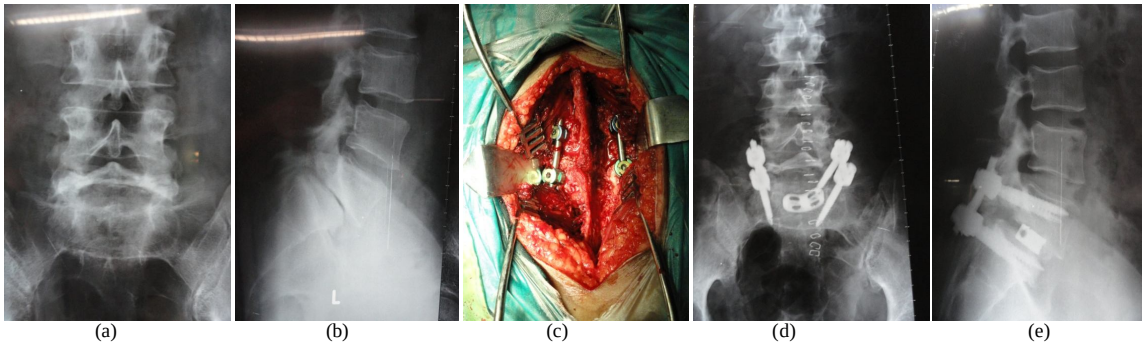
Materials and Methods

This prospective interventional study was performed from July 2008 to June 2011 in our official and private setup. The patients with unstable Spondylolisthesis grade I-II were included but with the followings were excluded: i) Spondylolisthesis >grade II; ii) Previous history of spondylo-discitis; iii) Medically unfit patients. We included 30 patients (male 07, female 23); within an age range of 30-59 years. All the patients were evaluated preoperatively by X-ray L/S spine A/P, Lateral [Figure-1(a) and Figure-2(a)] and oblique view. Flexion- extension films were done to assess the instability. MRI of the L/S spine [Figure -1(b) and Figure -2(b)] was done routinely to delineate the intra spinal neurological condition. Nineteen cases were lytic, 08 cases were degenerative, 02 were post-traumatic and 01 dysplastic variety of spondylolisthesis. The $L_{4/5}$ level was involved in 17 cases, L_5/S_1 level in 10 cases and $L_{2/3}$ level in 03 cases. Fourteen patients had sensory involvement, 10 patients had motor involvement and 05 had loss of reflexes.

Follow ups: Follow up ranged from 12 to 24 months and outcome assessed regarding pain, disability and achievement of fusion. All the cases were evaluated both preoperatively and postoperatively regarding the clinical outcome and improvement of pain and disability status. Follow up was consecutively at 3 months, 6 months and 12 months followed by 6 months interval thereafter. All the patients were evaluated clinically to assess the neurological status.

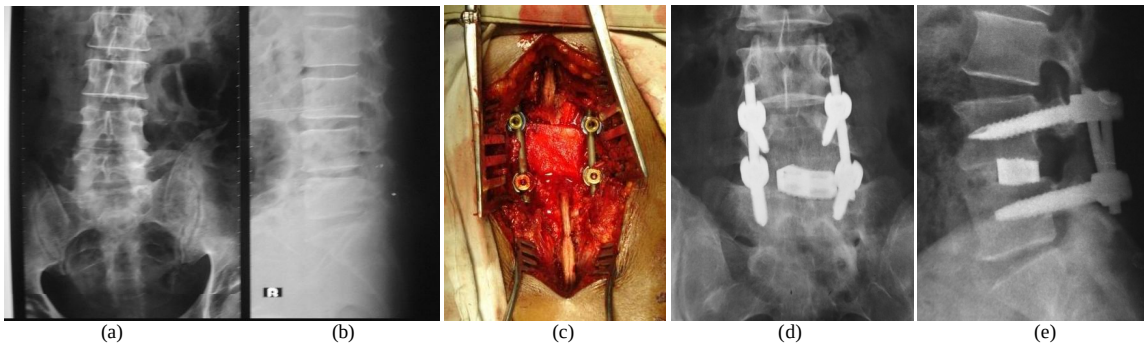
Assessment: We assessed the patients with Visual Analogue Score (VAS)[15] and Oswestry Disability Index (ODI)[16] at every follow-up. Every patient had done check X-ray L/S spine A/P and lateral view [Figure-1 (d), (e) and Figure-2 (d), (e)] and send to a radiologist for comments about the fusion status with blinding. Computed Tomography (CT) scan had been reserved for cases where radiological fusion was doubtful or in cases with pseudoarthrosis. The patients were documented with the standard VAS and ODI questionnaire to assess the improvement of the pain and disability status in every follow-up. We have graded the overall comprehensive outcome of the study by the Macnab`s criteria[17] as follows; Excellent: Full recovery of symptoms and no restriction of occupational or daily activities**;** Good: Residual or occasional symptoms but able to continue normal activities; Fair: Partial recovery of symptoms, unable or difficulty to continue work; Poor: No recovery or worsening of symptoms. Statistical analysis was done by unpaired t-test and chi-squared test in appropriate instances.

The operative technique: We used the posterior midline incision followed by subperiosteal muscular dissection. The lateral margin of the facet joints as well as the transverse processes was identified to determine the site of pedicle. Pedicle screws were inserted using the freehand technique and checked for proper placement by C-arm. Unilateral laminotomy and partial facetectomy were performed on the side consistent with the patient's symptoms. The disc space was gradually distracted by using the pedicle screws and rods with distractors. Annulotomy done over the posterolateral portion of the annulus and the entire discs were removed. Endplates was curetted out by the specially designed box currettes with carefully protecting the thecal sac and nerve roots. We took the morcelized bone grafts from the excised spinous process and parts of laminae and introduced to the anterior part of the disc space and impacted with an impactor. The serial cage template was inserted and the interbody cage of appropriate size, packed with bonegraft was placed within the space and checked for proper positioning. Once the cage with graft has been placed, pedicle screws are then attached to lordotic rod [Figure-1(c) and Figure-2(c)] and compressed to restore the lumbar lordosis. The exiting nerve roots were decompressed and the traversing roots were checked for any residual compression. Laminae and the remaining contralateral facet joint are decorticated, and packed with local autologous graft taken from the excised spinous process and part of laminae. The lateral intertransverse space was also packed and wound was closed with a drain insitu.



(a) (b) (c) (d) (e)

Fig.1: Patient with grade–II Spondylolisthesis with instability at L_5 over S_1. The preoperative A/P and lateral view of L/S spine (a,b); The intraoperative view of instrumentation (c); The A/P film showing the sagittal orientation of hardware (d); The Postoperative lateral film showing restoration of anatomy and good position of hardware (e).



(a) (b) (c) (d) (e)

Fig. 2: Patient with grade–I Spondylolisthesis with instability at L_4 over L_5. The preoperative A/P and lateral view of L/S spine (a,b); The intraoperative view of instrumentation (c); The A/P film showing the sagittal orientation of hardware at 1 year follow up (d); The lateral film of same follow up showing restoration of anatomy and good position of hardware and achievement of fusion (e).

Results

The prospective interventional study was carried out in Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Shahbag and other private hospital in Dhaka from July 2008 to June 2011. Total 30 cases, age ranging from 30 to 59 years, mean age 46.75±05.65 years were included. Maximum 18(60.00%) patients were in 40-49 years age group followed by 10(33.33%) patients in 50-59 years age group. Out of these patients 23(76.67%) were female, male: female ratio 1:3.67 with a female predominance ($p<0.05$). Housewives were 23(76.67%) & other 05(16.67%) were manual workers and 02(06.67%) were sedentary workers (Table-I). There were 19 (63.33%) cases with lytic, 08(26.67%) cases were degenerative, 02(06.67%) were post-traumatic and 01(03.33%) dysplastic variety of spondylolisthesis. Among the patients 17(56.67%) Involved L_4 over L_5, 10(33.33%) Involved L_5 over S_1 and 03(07.50%) cases Involved L_3 over L_4. Patients of spondylolisthesis grade-I (25% slip) found in 11(36.67%) cases, grade-II (50% slip) was found in 19(63.33%) cases.

Table-I: Demographic variables of the patients. (n=40)

Age (yrs.)			Mean	Sex			Occupation		
Group	No.	Percent.			No.	Percent		No.	Percent.
30-39 years	02	06.67		Male	07	23.33	Sedentary worker	02	06.67
40-49 years	18	60.00	46.75 ± 05.65	Female	23	76.67	manual worker	05	16.67
50-59 years	10	33.33					Housewife	23	76.67

All the patients were followed up in a period for minimum 12 months. Table-II describes, 18 (60.00%) patients had preoperative radiculopathy but post operatively all the patients significantly ($p<0.05$) improved from their preoperative status and had no residual radicular involvement at 1 year. Preoperatively 14 (46.67%) patients had sensory, 10 (33.33%) patients had motor and 05 (16.67%) patients had loss of reflexes but all of them recovered postoperatively to normal status ($p<0.05$). The pain intensity of all the patients was assessed by Visual Analogue Score (VAS) and all the patients had significant improvement of low back pain and leg pain status post-operatively. As in Figure-3 the mean preoperative low back pain score was 07.75±02.67 which was improved postoperatively 02.25±01.45($p<0.05$) at 1 year. The mean preoperative leg pain score was 05.25±02.54 which was improved postoperatively 01.75±00.85 ($p<0.05$) at 1 year. The mean preoperative disability score by Oswestry Disability Index (ODI) was 56.75±07.83 which was improved significantly to 09.81±02.65 at 1 year follow up ($p<0.05$) and 29 patients returned to their previous level of activity. The duration of the hospital stay ranged from 05 to 13 days, mean 06.25±03.35 days. Fusion was achieved within 6 months postoperatively at 23.25±04.75 weeks. One (03.33%) patients had superficial wound infection and 01(03.33%) patient had persisted low back pain. Satisfactory results were achieved in 37(93.33%) cases.

Table-II: Preoperative, postoperative and outcome status of the patients. (n=40)

Outcome variables		Preoperative	Postoperative (at 1 year)
Low back pain		30 (100%)	01 (03.33%)
Radiculopathy		18 (60.00%)	00 (00.00%)
Neurological status	Motor involvement	10 (33.33%)	00 (00.00%)
	Sensory involvement	14 (46.67%)	00 (00.00%)
	Reflex involvement	05 (16.67%)	00 (00.00%)
Functional and radiological outcome			
Variables	Assessment Criteria	Preoperative	Postoperative (At 1year)
Low Back Pain	Visual Analogue Score (VAS)	07.75±02.67	02.25±01.45
Leg Pain		05.25±02.54	01.75±00.85
Disability	Oswestry Disability Index (ODI)	56.75±07.83	09.81±02.65
Comprehensive outcome according to Macnab`s criteria			
Excellent	20 (66.67%)		
Good	08 (26.67%)	Satisfactory	28 (93.33%)
Fair	02 (06.67%)		
Poor	00 (00.00%)	Unsatisfactory	02 (06.67%)

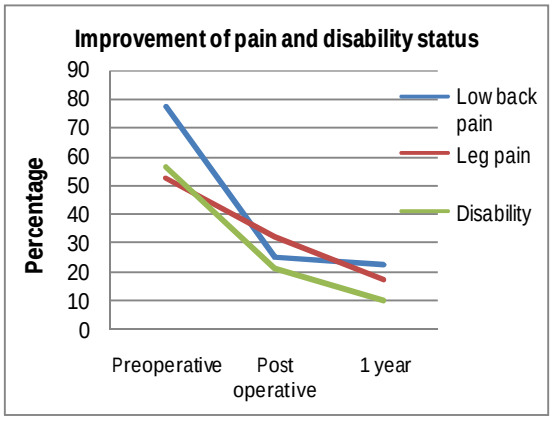


Figure-3: Improvement of pain and disability status

Discussion

TLIF is a very good alternative technique which can theoretically prevent typical disadvantages of those seen in anterior and posterior lumbar interbody fusion[18]. Hee et al[19] compared TLIF with combined anterior and posterior fusion concluding that TLIF patients had a shorter operative time, less blood loss and shorter hospital stay compared to single stage anterior and posterior fusion. Humphreys et al[20] compared Posterior Lumbar Interbody Fusion (PLIF) and TLIF showing that TLIF had a much lower complication rate. Brislin and Vaccaro[21] have reported lower risk of nerve tethering in TLIF compared to traditional PLIF. These study reports had definite influence regarding the adoption of TLIF as a surgical method of choice. The operating time was 190 minutes averaged in our series and preoperative blood loss in our single level surgical intervention was average 215ml and required only 1 unit of blood transfusion almost in every case. We ended up with superficial wound infection in 02 cases which were improved by broad spectrum antibiotic administration according to sensitivity report and regular dressing. One case needed debridement. Elmasry et al[22] ended up with 01(03.33%) case of superficial wound infection and another 01(03.33%) with postoperative transient paraesthesia. None of our cases had neurological involvement postoperatively. Hospital stay was 06.25±03.35 days postoperatively which is also comparable to different other series.

In our series there were 07 male and 23 female within an age range of 30-59 years. The mean age was 46.75±05.65 years and male to female ratio 1:3.67 showing a female predominance. Our series shows results contrary to Elmasry et al[22] who showed male dominance (13 females and 17 male) in his series. We have performed only single level surgery where 17(56.67%) cases were at $L_{4/5}$ comparable to Elmasry et al[22] (20 out of 33). Even with 19(63.33%) cases with grade-II and 11(36.67%) cases with grade-I unstable spine, overall 18(60.00%) patients had preoperative neurological involvement indicating a relatively advanced presentation but complete recovery at 1 year follow-up. All patients had significantly improved low back pain and leg pain status as well as the disability status at 1 year. Sebastian et al[23] also showed reduction of disability score from preoperative 23.50% to postoperative 13.50% which is comparable to ours.

All (100%) of our patients achieved fusion within 6 months postoperatively at 23.25±04.75 weeks. These cases were evaluated by CT scan at 6 months follow up determining adequate achievement of fusion. All the patients returned to their previous level of activity except 01 with infection requiring debridement. The patient needed occasional analgesics to get relieved from pain which was limiting his level of activity. Satisfactory (Excellent and good) results were achieved in 37 (93.33%) cases. Elmasry et al[22] reported 90% excellent or good result with 91% fusion in his series of 30 patients with low grade spondylolisthesis treated by TLIF. Yehya[23] found 73.30% excellent and 26.70% good result with TLIF in 30 patients with spondylolisthesis. Lowe et al[24] reported 85% good and excellent clinical results, with 90% radiological fusion in his series of TLIF with two cages.

The study had limitations because we had no cases to include with unstable upper lumbar spondylolisthesis or even multiple level instabilities requiring fusion, without which a rational conclusion of using TLIF is difficult to determine. A larger sample size with a long period study might include such cases. The period of study is not sufficiently long to conclude regarding more specified outcome regarding the hardware and its long-term functional and structural effect. Studies with larger population comparing with the specialized centers would help to find out even more advanced method of surgical management.

Conclusion: Transforaminal lumbar interbody fusion is an effective method for surgical management of low grade spondylolisthesis. The complications rate is less and provides good fusion and functional outcome.

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