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Clinical evaluation of lumbar interbody fusion (PLIF/TLIF) done for spondylolisthesis at L4-L5 level

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Abstract

Lumbar pain due to spondylolisthesis (DLS) in the elderly especially the rural Indian population involved in farming and agriculture hard work is a common and incapacitating problem.

Aims: Degenerative Lysthesis of L4-L5 level is commonly observed with associated disc degeneration leading to foraminal stenosis causing radiculopathy and neuroclaudication.

Methods and Material: We have done a short term prospective follow- up of 26 patients treated with posterior lumbar interbody fusion (PLIF) with titanium pedicular screws and cage for L4-L5 degenerative spondylolisthesis (DLS) for 1, 3, and 6 months after surgery using Japanese Orthopaedic Association (JOA) criteria and MacNab's criteria.

Statistical analysis used: Chi- Square Test or Mc Nemers Chi- Square Test.

Results: The rate of improvement as calculated from the JOA score improved from 8.34 preoperatively to 72.19 at 6 months post-operative after PLIF for DLS and also good to excellent results in 84.61% cases according to Mac Nab's criteria.

Conclusions: Hence we conclude that PLIF for DLS significantly improves quality of life post – operatively because of relief of back pain and neurological symptoms.

Keywords: lysthesis, degenerative, fusion, neuroclaudication

1. Introduction

Degenerative Lumbar Spondylolisthesis (DLS) is a very common cause of severe back pain chronic in nature and affecting the elderly with subsequent neuroclaudication and leg, thigh and buttock pains incapacitating and restricting the activities of daily living of elderly. Our study includes the patient clientele that includes the rural population of our region of India and Marathwada that attend our Out Patient Department. These patients indulge in rural agriculture hard work involving repetitive lumbar flexion actions causing accelerated degeneration at L4-L5 level. It was first described by Junghanns as pseudospondylolisthesis in the year 1931 and subsequently by Macnab in 1950^[1, 2]. The concept of degenerative spondylolisthesis (DLS) was refined and presented in modern way by Newman in 1955^[3]. In their instructional course lectures of the American Academy of Orthopaedic Surgeons (AAOS), Bolesta and Bohlman have described the etiology, pathogenesis with emphasis and surgeries for the treatment of DLS.^[4-6]

Surgical management when indicated for the management for DLS has ranged from simple decompressive laminectomies to spinal arthrodesis, nowadays called spinal fusion surgeries to the use of instrumentation and of late, the use of devices used between vertebral bodies called as cages.^[7-15] Spinal arthrodesis implies fusion of joints around the vertebral disc unit involving articular facets or vertebral interbody region.^[16-26]

Cloward is credited with describing the technique of posterior lumbar interbody fusion called as (PLIF).^[27] The original described technique was later modified in many ways by other surgeons as described in literature by Steffee AD, Sitkowski DJ, Roy-Camille R, Saillant G, and Mazel C.^[28,29] Various comparative studies have been done between PLIF and posterolateral fusion and the complications of PLIF commonly seen in the long term like adjacent segment degeneration have been documented.^[30-35] Recently surgeons are doing endoscopic assisted PLIF surgeries.^[36]

The purpose of this study was to evaluate the short term functional outcome of PLIF in patients operated for L4-L5 degenerative spondylolisthesis with regards to the MacNab's score

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and Japanese Orthopaedic Association criteria and monitor patient satisfaction after surgery till 6 months.

Materials and methods

Study area and study population

26 patients were included in this prospective study, conducted in the department of neurosurgery and department of orthopaedics at each of the authors working places, between august 2016 to December 2018. Patients were considered for the study if they fulfilled following criteria.

Inclusion Criteria

1. Patient aged 50 years and above.
2. Single level L4- L5 Degenerative Spondylolisthesis (DLS).
3. Failure to respond to non-operative treatment.

Exclusion criteria

1. Patients below the age of 50 years.
2. Multiple level disc herniation
3. Vertebral fractures.
4. Disc prolapse with bowel and bladder symptoms (cauda equina syndrome).
5. Patient with scoliosis or kyphosis.
6. Patients with spinal infection.

Sampling

Time period of study: August 2016 to December 2018

With the incidence rate of L4/5 DLS cases undergoing surgery 0.07% [70/100000] at 95% confidence interval and ± 1 margin of error the sample size is $n = 26$.

$$n = \frac{(Z_{\alpha})^2 \times p \times q}{d^2}$$

Hence a minimum number of 26 patients were included in this study.

Statistical Analysis

Diagrammatic presentation

Mean \pm S.D.

Chi- Square Test or Mc Nemers Chi- Square Test.

Paired 'T' test or suitable non-parametric test in case of skewed data (if necessary).

The study was approved by local ethics committee.

Technique: A detailed history was obtained at the time of admission and all the patients were subjected to thorough clinical examination. All patients were subjected MRI.

The findings obtained therein were noted in a standard proforma.

All the cases were assessed preoperatively and postoperatively with the Japanese Orthopaedic Association low backache score. The results of surgery are evaluated using Mac Nab's criteria.

After detailed clinical evaluation, the patients had undergone relevant investigations like:

1. X-ray Lumbo-Sacral spine both anteroposterior (AP)/Lateral Views lateral flexion and extension views in standing position.
2. MRI whole spine.
3. Blood routine-Hb%, BT, CT, FBS, PPBS, Blood urea, Sr. Creatinine.
4. Chest X-ray.
5. ECG / echocardiography for fitness for anaesthesia.

6. Consent of the patient for the surgery.

Technique of surgery

All the patients were operated in prone position in knee chest position on bolsters. The surgical procedure carried out was conventional standard central midline exposure with sideways exposure of L4 and L5 facets and lateral soft tissues right upto the tip of the transverse processes. Bilateral L4 and L5 titanium pedicular screws were inserted under C-arm guidance on anteroposterior and lateral visualisation and confirmation. Interconnecting rod of any one side was applied after midline exposure and screw insertion L4-5 laminectomy was done. Bilateral L4 and L5 traversing and exiting nerve roots were identified and protected, epidural veins were cauterised with bipolar cautery. Intervertebral disc was identified and thorough complete discectomy was done with the help of curettes, interbody dilators and reamers provided by the concerned company for ease of interbody disc space preparation and cage insertion. Once disc space is prepared for cage insertion trial cage inserters were used to assess the size of the cage, which are provided by the company and intra operative c arm visualization helps assess perfect size of the interbody cage to be used. Then the unilateral rod that was applied is distracted slowly under physiological limits carefully and judiciously. Anterior part of the disc space is filled with bone graft harvested and prepared from the laminectomy bone received by the O T assistant. Cage is placed or tapped into the position. Care is taken not to put it in loose fashion or overdistract the disc space. Final position of the cage is confirmed under C-arm. Both connecting rods are placed in position. Slight compression of rods is done to further hold the intervertebral cage tight in position and enhance stability and fusion. Average duration of surgery: 2 hours min with a range of 2-4.5 hours depending on built of the patient.

Average loss of blood: 200 ml with a range of 70 ml – 350 ml.

Blood transfusion was required in 7 patients. One patient with dural tear required suturing of dura with absorbable suture (No. 4.0 vicryl) and a fat graft. Epidural bleeding was controlled by bipolar cautery and packing. 1 case of superficial wound infection required wound dressing and three days of antibiotics.

All patients were catheterised for 24 hrs post-surgery.

Fortunately none of the above complications affected the final outcome.

Post-operative management

Post-operative intravenous antibiotics for 48 hours and analgesia either intravenous or orally for 48-72 hours depending on pain was administered. Neurological function was monitored. Turning in bed was allowed on the operative day. Patients were allowed to sit up on 2nd post-operative day. Lower limb strengthening exercises were started on 2nd post-operative day. Back strengthening exercises were started on 14th post-operative day. Patient were mobilized with brace on 2nd post-operative day. Sutures were removed on 12th post-operative day. Stooping and flexing the spine excessively were avoided by patients on advice. At discharge patient were advised not to strain the back or lift weights. Patients were instructed to minimize sitting and riding in a vehicle 3 months post-operatively.

Japanese Orthopaedic Association

(JOA) rating scale was used to determine the outcome apart

from Mac Nabs's criteria. The total score represents the sum of subjective symptoms and objective findings. [37]

Table 1: Japanese Orthopaedic Association's Low Back Ache Score

1	Subjective symptoms	Score
A	Low Back pain (3 points)	
a)	No Low Back z pain	3
b)	Occasional mild low back	2
c)	Low back pain always present / Severe low back pain occurs occasionally	1
d)	Severe low back pain always present	0
B	Leg pain and / or tingling (3 points)	
a)	No lower extremity pain or numbness	3
b)	Occasional mild lower extremity pain and numbness	2
c)	Lower extremities pain and numbness always present / Severe lower extremities pain and numbness occur occasionally	1
d)	Severe lower extremities pain and numbness always present	0
C	Ability to walk (3 points)	
a)	Normal walking	3
b)	Walking at least 500m is possible, but pain, numbness & weakness are felt	2
c)	In walking 500m or less, pain, numbness and weakness occur, and Walking becomes impossible.	1
d)	In walking at most 100m, pain, numbness and weakness occur, and Walking becomes impossible.	0
2	Objective findings	Score
A	straight leg raising test (SLRT)	
a)	Normal	2
b)	30 degree – 70 degree	1
c)	Less than 30 degree	0
B	Sensory Abnormality	
a)	Normal	2
b)	Mild sensory disturbance (Hypoesthesia)	1
c)	Distinct sensory symptoms (Anesthesia)	0
C	Motor Abnormality	
a)	Normal	2
b)	Slightly decreased muscle strength	1
c)	Markedly decreased muscle strength	0
	Total score	15

$$\text{Rate of Improvement} = \frac{\text{postoperative score} - \text{preoperative score}}{15 - \text{Preoperative score}} \times 100$$

Observations and results

Observations

Total 26 patients were included in the study. All 26 patients were available for follow up by visits. All the patients were followed up at the interval of 1 month, 3 months and 6 months. At the end of 1 month and 6 months assessment was done of subjective and objective findings with Japanese Orthopaedic Association (JOA) score and Rate of improvement (RI) was calculated. Out of 26 patients 18 were men and 8 were women. Age ranges from 28 years to 72 years. Mean age being 47.8 years. In males age ranged from 28-72 years with mean 46.6 years. In females' age ranged between 35-70 years with a mean age of 50.5 years. All of the patients had both back pain and leg pain. In almost all the cases back pain preceded leg pain (sciatica) except in one case who had complained leg pain to start with. 9 patients had (Rt) sided radiculopathy and 13 patients had (Lt) sided radiculopathy. 4 patients had bilateral leg pain.

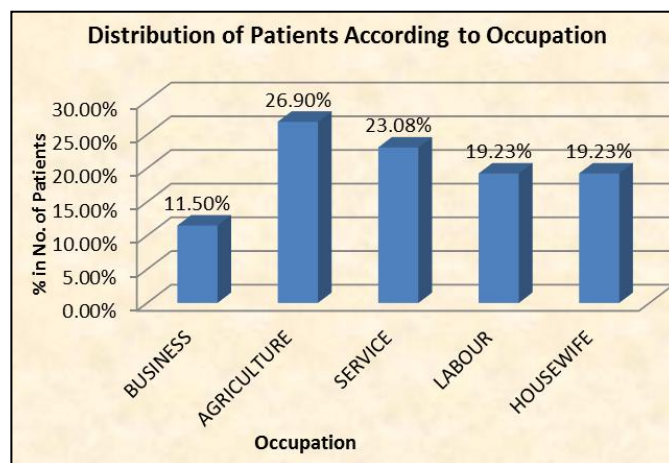


Fig 1: distribution of patients according to occupation

Table 3: Position of herniation

location of herniation	Patients	%
Central	12	46.15
Lateral	1	3.85
Par central	8	30.77
Posterior lateral	5	19.23

Table 4: Neurological symptoms

Symptoms	No of cases (n=26)	Percentage
Back pain	26	100
Radicular pain	26	100
Parasthesia	21	80.76
Muscular weakness	17	65.38
Sensory symptoms (hypoesthesia/anesthesia)	7	26.92
Visceral involvement (bowel / bladder)	0	0

All 26 patients had undergone conservative therapy in the form of Bed rest, traction, analgesics or physiotherapy before undergoing our PLIF procedure.

Table 5: Neurological Deficits

Deficit	Mild	Moderate	Severe
Sensory deficit	5	1	1
Motor deficit	11	4	2

Table 6: Immediate complications of surgery

Complications	Frequency
Dural tear	1
CSF leak	0
Significant epidural bleeding	5
Wound infection	1
Discitis	0
Neural damage	0

Surgical outcome

For analyzing the clinical outcome of PLIF technique for DLS, we have used

Japanese Orthopaedic Association score for pre-operative and post-operative objective and subjective symptoms and Rate of improvement at 1 month and 6 months.

Mac Nab's criteria of outcome.

A. Excellent: No pain; no restriction of mobility return to normal work & level of activity

B. Good: Occasional no radicular pain relief of presenting symptoms; return to modified work

C. Fair: Some improved functional capacity still handicapped

and unemployed.

D. Poor: Continued objective symptoms of root involvement; additional operative intervention needed at the index level irrespective of length of postoperative follow-up.

Out of 26 patients at the time of discharge, 20 patients (87.5%) could walk independently without any aid and without any radicular pain. 6 patients with little radicular pain and with support.

In most of the patients 19 (73.07%) sciatica improved immediately.

The clinical outcome of 26 patients after a mean follow up of 6 months is as follows:

Table 7: JOA score and Rate of improvement Mean score.

JoA	Mean
Pre oper	8.346
After 1 month	11.807
After 6 month	13.19
Rate of imp.1 m	51.635
Rate of imp.6 m	72.191

Table 8: Mac Nab's criteria

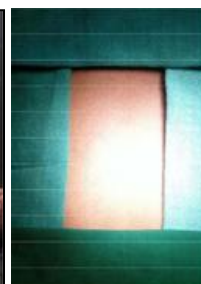
Mac Nab's criteria	Frequency	Percentage
Excellent	10	38.46
Good	12	46.15
Fair	2	7.69



A: Intraoperative Prone Position of Patient and C-Arm



B: Skin Marking For Midline Incision



C: Exposure in midline till tips of transverse process bilaterally



D/E: Bilateral Pedicle Screw Insertion



F: Interbody Trial of Cage Size after Discectomy



G: Bone Graft for Interbody Cage



H: Final Picture after Cage and Rod Application with Decompressed Spinal Canal



I/J: Pre-Op Xrays and Mri, K- Post Op Xray At 6 Months





I/J: Pre-Op Xrays and Mri, K- Post Op Xray At 6 Months



K: Technique of Plif

Discussion

In our study of 26 cases, our management involved posterior lumbar inter body fusion with decompression. All patients during their follow up showed an improvement in their clinical and functional outcome with regards to backpain and leg symptoms and effective return to their normal lifestyle.

The goal of PLIF in spondylolisthesis is to relieve backpain and the neurological deficit, to provide stability by fusion. Posterior approach and technique of fusion has distinct advantages over anterior approach because of its ease and accessibility and acquaintance of surgeon, it permits exploration of the defects, nerve roots and intervertebral discs. In addition it is relatively safe. A high rate of successful fusion by the posterior lumbar inter body fusion technique has been reported by Watkins, Wiltse and others. PLIF for DLS has definite biomechanical, anatomic, and physiologic advantages of interbody. Interbody support restores disc space height, facilitates correction of alignment and balance, prevents progression of subluxation, and provides load sharing to prolong the life of instrumentation. As the anterior and middle spinal columns support 80% of the spinal load, placing the bone graft loaded cage in this load-bearing position subjects it to compressive forces that enhance bony fusion [38]. Adding posterior lumbar interbody fusion to pedicle screw fixation and posterior fusion after decompression in spondylolisthesis enhances fusion and stability leading to better functional outcomes and lower incidence of post-operative backpain [39].

Posterior lumbar interbody fusion yields a satisfactory and long lasting result and remains the gold standard against which other surgical treatment must be compared.

The interbody fusion immediately produces a biomechanically stable postoperative spine, thus enhancing the opportunity for arthrodesis.

Conclusion

In our study there is a good correlation between interbody fusion and functional outcomes. Early return to work with better clinical and functional outcomes is observed with PLIF for DLS. A long term study with a larger patient population with a detailed analysis of different types of interbody fusion devices could be done in future to establish the definitive role of CT in the assessment of interbody fusion and its associated long term outcomes or complications.

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