ORIGINAL RESEARCH

CLINICAL AND RADIOLOGICAL OUTCOME OF TLIF WITH AUTOLOGOUS BONE GRAFT IN LUMBAR CANAL STENOSIS

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Received: 02Sept, 2023 Accepted: 25Sept, 2023

Abstract

Introduction: Lumbar canal stenosis is reduction in the diameter of the spinal canal or neural foramina. Neurogenic claudication is the most common complaint of these patients. Foraminal decompression is incomplete in regular decompressive procedures.

Aims and Objectives: This study aims to find out the clinical and radiological improvement in TLIF with autologous bone graft for lumbar canal stenosis.

Methodology:A prospective cohort study of 39 patients with diagnosed severe lumbar canal stenosis graded clinically with Claudication distance, ODI & JOA scores &radiologically according to MRI grading underwent Transforaminal Lumbar Interbody fusion by the same group of similarly trained surgeons and were followed up for 1.5 years and assessed for improvement in Claudication distance, JOA and ODI scores clinically at 1,3,6 & 12 months and radiologically were assessed with regular post op x-rays at 1 month and 1 year and fusion rate was assessed with the help of Birdwell classification for fusion.

Results: Out of the 39 patients 17 were females and 22 were males with mean age of 51 years. The claudication distance improved from 0.05±0.025 kilometres preoperatively to 1.78±0.47kilometres at 1 year postoperatively. The ODI score improvement from 79.64±2.91 preoperatively to 24.66±2.95 at 1 year postoperatively. The JOA scores improved from 4.87±0.76 preoperatively to 10.87±0.97 postoperatively at 1 year.

Conclusion: There is considerable improvement in the patients clinically as seen with the CD, ODI and JOA scores postoperatively. The maintenance of disc height and foraminal height postoperatively co-related well with the clinical improvement seen with the patients.

Keywords: Claudication, ODI & JOA score, TLIF, cages, autologous bone grafts, birdwellct classification, fusion grade

Introduction

Lumbar degenerative spine disease (DSD) is a common cause of disability, yet a reliable measure of its global burdendoes not exist. A metanalysis1 reported that 266 million individuals (3.63%) worldwide have DSD and LBP each year; the highest and lowest estimated incidences were found in Europe (5.7%) and Africa (2.4%), respectively. Based on population sizes, low- and middle- income countries have 4 times as many cases as high-income countries. Thirty-nine million individuals (0.53%) worldwide were found to have spondylolisthesis, 403 million (5.5%) individuals worldwide with symptomatic disc degeneration, and 103 million (1.41%) individuals worldwide with spinal stenosis annually.Central stenosis is the most common form of LSS which occurs at the disc level when the central spinal canal is narrowed secondarily to osseous and/or ligamentous thickening following degenerative changes.[2,3]

Various earlier morphometric studies have demonstrated that this abnormality may involve the transverse, sagittal, or both the diameters of the canal.[4,5]

Aim of the study is to attain bony fusion of adjacent vertebral bodies, total decompression of the nerve

roots and disc height realignment. Using different approaches, fusion materials and fixations, many techniques for fusion has been adopted. Lumbar canal stenosis (LCS) is decrease in the space within the central canal or lateral foraminal canal.[6]

The most common complaint of the patients with stenosis is neurogenic claudication where they present with pain after exertion which radiates to buttock and lower limbs, leading to functional disability and decreasing their walking capacity.[7]

So, the main need for this study is to find an appropriate procedure that can reduce the severe debilitating symptoms and provide a long-term relief to the patients.

This procedure is also cost saving as Titanium Cages that are usually put for regular fusion procedures are not used and replaced by local autogenous bone graft to achieve interbody fusion. This also reduces the neural & vascular complications of placing cages like epidural hematoma, meningitis, dural tears & Cage dislodgments.

Materials and Methods

It was a Cohort study done in Spine Department at Sanjay Gandhi Hospital of Trauma &Orthopaedics, Bangalore for a period of one and half year (JUNE 2022 to DECEMBER 2023) among 39 patients. Purposive sampling for patient's satisfying eligibility criteria was used. Study population with a lumbar canal stenosis of Grade 2 or more for central canal stenosis and Grade I or more for foraminal stenosis on the MRI along with severe disability according to the ODI index and JOA score of 7 or lesser in Spine Department at Sanjay Gandhi Hospital of Trauma &Orthopaedics, Bangalore, India.

Sample size calculation[8]

S=z2pq/d2
= 1.96X1.96X0.02X0.98/0.5X0.5
=39

Inclusion & Exclusion criteria

Inclusion Criteria

1. Age more than 18 years
2. Patients of lumbar canal stenosis with
3. JOA score of 7 or lesser
4. ODI grading of Severe Disability
5. MRI of grade II and above for central canal stenosis or Grade I and above in case of foraminal stenosis.

Exclusion Criteria

- Failed back cases.
- Patients having trauma or tumours or spondylolisthesis as the cause of the lumbar canal stenosis.
- Patients who are lost for follow up.

Study Conduct

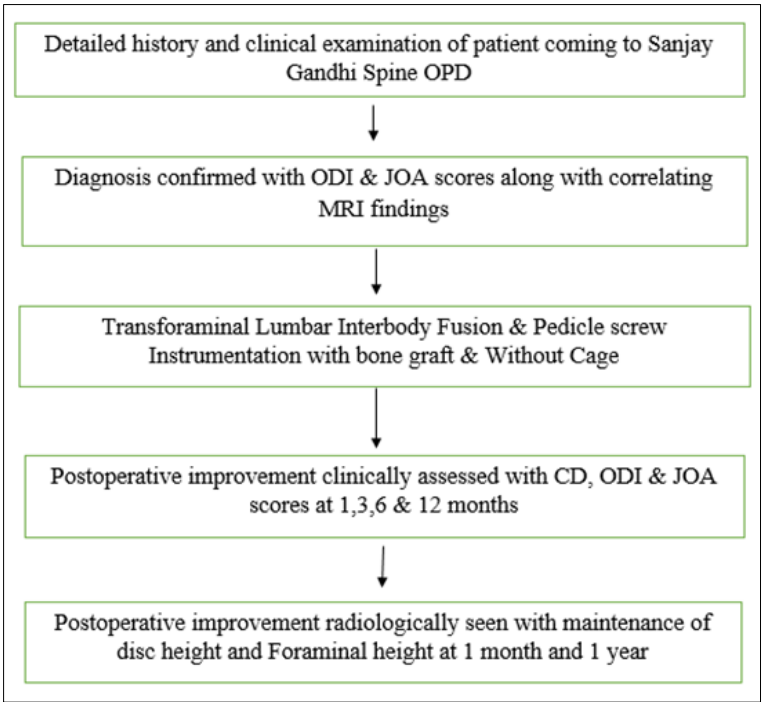

Fig 1:

Methodology: Detailed History taking including back pain and Claudication distance and duration, progression of the symptomsand any improvement of the symptoms with any treatment received.

Through clinical examination which includes

- Forward and backward bending of Lumbar spine to check for aggravation of pain on backward bending.

- Tenderness over the Lumbo –sacral spine
- Active & Passive Straight leg raising test
- PATRIK test
- Lasegue's Sign
- Any Sensory or Motor Deficits

If the signs do not correlate for the symptoms, then we ask the patient to walk for a distance more than his/her claudication distance and re-examine for relevant findings.

The ODI score and JOA score of the patients were calculated

SECTION 1 - PAIN INTENSITY
- ☐ I can tolerate the pain I have without having to use painkillers.
- ☐ The pain is bad but I manage without taking painkillers.
- ☐ Painkillers give complete relief from pain.
- ☐ Painkillers give moderate relief from pain.
- ☐ Painkillers give very little relief from pain.
- ☐ Painkillers have no effect on the pain and I do not use them.

SECTION 2 - PERSONAL CARE (washing, dressing etc.)
- ☐ I can look after myself normally, without causing extra pain.
- ☐ I can look after myself normally, but it causes extra pain.
- ☐ It is painful to look after myself and I am slow and careful.
- ☐ I need some help, but manage most of my personal care.
- ☐ I need help every day in most aspects of self-care.
- ☐ I do not get dressed, wash with difficulty and stay in bed.

SECTION 3 - LIFTING
- ☐ I can lift heavy weights without extra pain.
- ☐ I can lift heavy weights, but it gives extra pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned (e.g., on a table).
- ☐ Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can lift only very light weights.
- ☐ I cannot lift or carry anything at all.

SECTION 4 - WALKING
- ☐ Pain does not prevent my walking any distance.
- ☐ Pain prevents me walking more than 1 mile.
- ☐ Pain prevents me walking more than ½ of mile.
- ☐ Pain prevents me walking more than ¼ mile.
- ☐ I can only walk using a stick or crutches.
- ☐ I am in bed most of the time and have to crawl to the toilet.

SECTION 5 - SITTING
- ☐ I can sit in any chair as long as I like.
- ☐ I can sit in my favourite chair as long as I like.
- ☐ Pain prevents me sitting more than 1 hour.
- ☐ Pain prevents me from sitting more than ½ an hour.
- ☐ Pain prevents me from sitting more than 10 minutes.
- ☐ Pain prevents me from sitting at all.

SECTION 6 - STANDING
- ☐ I can stand as long as I want without extra pain.
- ☐ I can stand as long as I want but it gives me extra pain.
- ☐ Pain prevents me from standing for more than 1 hour.
- ☐ Pain prevents me from standing for more than 30 minutes.
- ☐ Pain prevents me from standing for more than 10 minutes.
- ☐ Pain prevents me from standing at all.

SECTION 7 - SLEEPING
- ☐ Pain does not prevent me from sleeping well.
- ☐ I can sleep well only by using tablets.
- ☐ Even when I take tablets, I have less than 6 hours sleep.
- ☐ Even when I take tablets, I have less than 4 hours sleep.
- ☐ Even when I take tablets, I have less than 2 hours sleep.
- ☐ Pain prevents me from sleeping at all.

SECTION 8 - SEX LIFE (If applicable)
- ☐ My sex life is normal and causes no extra pain.
- ☐ My sex life is normal but causes some extra pain.
- ☐ My sex life is nearly normal but is very painful.
- ☐ My sex life is severely restricted by pain.
- ☐ My sex life is nearly absent because of pain.
- ☐ Pain prevents any sex life at all.

SECTION 9 - SOCIAL LIFE
- ☐ My social life is normal and gives me no extra pain.
- ☐ My social life is normal, but increases the degree of pain.
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests, e.g., dancing, etc.
- ☐ Pain has restricted my social life and I do not go out as often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have no social life because of pain.

SECTION 10 - TRAVELLING
- ☐ I can travel anywhere without extra pain.
- ☐ I can travel anywhere but it gives extra pain.
- ☐ Pain is bad but I manage journeys over 2 hours.
- ☐ Pain restricts me to journeys of less than 1 hour.
- ☐ Pain restricts me to short necessary journeys under 30 minutes.
- ☐ Pain prevents travel except to the doctor or hospital.

Fig 2: ODI Score[9]

Symptoms and signs	Evaluation and score	
Subjective symptoms		
Low back pain	None	3
	Occasional mild pain	2
	Occasional severe pain	1
	Continuous severe pain	0
Leg pain and/or tingling	None	3
	Occasional slight symptoms	2
	Occasional severe symptoms	1
	Continuous severe symptoms	0
Gait	Normal	3
	Able to walk farther than 500 m although it results in symptoms	2
	Unable to walk farther than 500 m	1
	Unable to walk farther than 100 m	0
Clinical signs		
SLR test	Normal	2
	30-70°	1
	Less than 30°	0
Sensory disturbance	None	2
	Slight disturbance (not subjective)	1
	Marked disturbance	0
Motor disturbance	Normal	2
	Slight weakness (MMT 4)	1
	Marked weakness (MMT 3 to 0)	0
Urinary bladder function	Normal	0
	Mild dysuria	-3
	Severe dysuria	-6

Fig 3: Japanese Orthopaedics Association score[10]

Statistical analysis

Statistical methods employed are Descriptive and Inferential. Mean, standard deviation, frequency and percent as descriptive statistics and Chi-square test, repeated measure ANOVA and paired t- test statistical tests were applied to find the significant difference between the groups. The software used for analysing this data is SPSS (21.0 version) for windows.P value < 0.05 was considered as statistically significant.

Results

Table 1: Age distribution

	Frequency	Percentage
30 - 50	22	56.4%
51 - 70	16	41%
>70	1	2.6%
Total	39	100%
Mean±SD	51.97±12.06	

In the current study, average age of the population is 51.97±12.06 years. Majority i.e. 56.4% belong to 30 -50 years' age group. 41% belong to 51 – 70 years' age group, 2.6% belong to >70 years' age group. In the present study, 56.4% are males and 43.6% are females. In the present study, Upper lumbar segment (L2-L4) stenosis is found in 17.9% and Lower lumbar segment (L4- S1) stenosis in 82.1%

Table 2: Procedure level

	Frequency	Percentage
L2 - L3	3	7.7%
L3 – L4	4	10.3%
L4 – L5	24	61.5%
L5 – S1	8	20.5%
Total	39	100%

Procedure is conducted at L2 to L3 in 3(7.7%), L3 to L4 in 4(10.3%), L4 to L5 in 24(61.5%) and L5 to S1 in 8(20.5%) of the patients.

Table 3: Pre-operative vs. post-operative CD

	Pre-operative	Post-Operative	P value
CD (Pre opvsPost op 1 month)	0.05±0.025	1.16± 0.38	<0.0001*
CD (Pre op vs Post op 3 month)	0.05±0.025	1.23±0.28	<0.0001*
CD (Pre op vs Post op 6 month)	0.05±0.025	1.41 ±0.30	<0.0001*
CD (Pre op vs Post op 1 year)	0.05±0.025	1.78 ±0.47	<0.0001*

The mean Pre-operative CD in Km is 0.05±0.025. At 1month post-operative it is 1.16± 0.38, at 3months it is 1.23±0.28, at 6 months it is 1.41 ±0.30, at 1 year it is 1.78 ±0.47. A significant improvement in CD in km postoperatively is observed. The mean Pre-operative CD in km is 0.05±0.025 and at 1 year is 1.78 ±0.47. When this was compared with 1 month,3 months, 6 months and 1-year postoperative values the observation was statistically significant as the p value calculated to be <0.05.

Table 4: Pre-operative vs. Post-operative ODI

	Pre-operative	Post-Operative	P value
ODI(prep vs post op1 month)	79.64±2.91	38.48±5.11	<0.0001*
ODI (prep vs post op 3 month)	79.64±2.91	38.23±5.03	<0.0001*
ODI (prep vs post op 6 month)	79.64±2.91	25.30±3.65	<0.0001*
ODI(prep vs post op1 year)	79.64±2.91	24.66±2.95	<0.0001*

The mean Pre-operative ODI is 79.64±2.91. When this was compared with 1 month,3 months, 6 months and 1-year postoperative values the observation was statistically significant as the p value calculated to be <0.05

Table 5: Pre-operative vs post-operative JOA

	Pre-operative	Post-Operative	P value
JOA (prep vs post op1 month)	4.87±0.76	9.89±0.78	<0.0001*
JOA (prep vs post op 3 month)	4.87±0.76	9.97±0.84	<0.0001*
JOA (prep vs post op 6 month)	4.87±0.76	10.87±0.97	<0.0001*
JOA (prep vs post op1 year)	4.87±0.76	10.87±0.97	<0.0001*

The mean Pre-operative JOA is 4.87±0.76. A significant raise in JOA score is seen at 1-month post-operative 9.89±0.78, at 3 months it is 9.97±0.84, at 6 months it is 10.87±0.97, at 1 year it is 10.87±0.97. This observation is statistically significant as the p value calculated to be <0.05.

Table 6: Preoperative vs Post-operative 1 year - Disk height

	Pre-operative	Post-Operative	P value
Disk height (prep vs post op1 month)	7.28±0.44	8.19± 0.41	<0.0001*
Disk height (prep vs post op1 year)	7.28±0.44	8.21±0.42	<0.0001*

The mean Pre-Operative Disk height is 7.28±0.44. A significant improvement in disk height at1-month post-operative 8.19±0.41, at 1 year was 8.21±0.42.This observation is statistically significant as the p value calculated to be <0.05.

Table 7: Preoperative vs Post-operative– Foraminal height (in mm)

	Pre-operative	Post-Operative	P value
Foraminalheight(in mm) (preopvs post op1 month)	7.51±0.68	13.12±1.80	<0.0001*
Foraminalheight(in mm)(preopvs post op1 year)	7.51±0.68	13.28±1.79	<0.0001*

The mean Pre-operative Foraminal height is 7.51±0.68. And at 1 year is 13.28±1.79. This observation is statistically significant as the p value calculated to be <0.05.

Table 8: Complications

	Frequency	Percentage
Recurrence of Claudication Pain	3	7.7%
Loss to follow up	2	5.2%

These figures show that 7.7% have recurrence of Claudication pain, where one patient had no relief of symptoms postoperatively which was followed up for 6 months to undergo revision surgery post which symptoms relived, another one had recurrence of symptoms within 1-month post- surgery, but gave history of profession with lifting heavy objects and high work load, the patient improved once adequate counselling was done for lifestyle modification and alternate profession. The 3rd patient with recurrence was lost to follow up after 1 month.

Discussion

Majority of the other studies compared also showed similar findings in terms of age, hence co- relating with our study, thereby proving that patients with Lumbar canal stenosis that are taken up for surgeries are more prevalent at this age group. In our study, the average age of the study sample is 51.97±12.06 years. Few studies show a female preponderance and few studies show male majority, hence leading to inconclusive results related to Gender distribution. In our study 56.4% seen are male and 43.6% seen are female.

Table 9:

Jain A *et al*[11]	52.4 years
Kakadiya*et al*[12]	50.97 years
Prasad *et al*[13]	45.72±7.7 years.
Present study	51.97±12.06

Table 10:

	L3-L4	L4-L5	L5-S1
Prasad *et al*[13]	25.7%	47%	23%
Pokhraj*et al*[14]	23%	45%	18%
Present study	10.3%	61.5%	20.5%

In the present study, Upper lumbar (L2-L4) stenosis is seen in 17.9% and Lower lumbar (L4-S1) stenosis is seen in 82.1% which is consistent with other studies thereby proving that lower lumbar segments are highly mobile segments and are more prone to degenerative changes and its ill effects. Out of the lower lumbar segments L4-L5 level involvement was the highest.

In one the study done by Klaus John Schnake*et al*[15], he stated that post TLIF for 26 patients the claudication distance preoperatively of 250 meters raised to more than 1000 meters postoperatively at 2 years which was comparable to our study where the pre-operative value of 50 meters went as high at 1700 meters postoperatively at 1 year. In a study done by Hans TROUILLIER16, fusion with cages and local bone graft showed that the CD improved by 500 meters postoperatively at 3.5 years in 75% of the study sample and more than 1 km in 55% patients which when compared to our study it provided a better result. In our study the mean Pre-operative CD in km is 0.05±0.025 and at 1 year is 1.78±0.47. This observation was statistically significant as the p value calculated to be <0.0

Table 11:

Jain A *et al*[11]	53.8±7.39
Kakadiya*et al*[12]	38.73±4.03
Prasad *et al*[13]	60.51±8.49
Present study	79.64±2.91

The mean Pre-operative ODI score is 79.64±2.91 and at 1 year is 24.66±2.95. This observation is statistically significant as the p value calculated to be <0.05. From the above tables when compared with similar study the ODI index of our study provided similar reduction in the values postoperatively at 1 year which suggests a good clinical outcome of our procedure compared to the others.

Table 12:

Prasad *et al*[13]	11.02±0.88
S.Fujibayashi *et al*[17]	16.2
Kei Watanabe *et al*[18]	11
Present study	4.87±0.76

The mean Pre-operative JOA score is 4.87±0.76 and at 1 year is 10.87±0.97. This observation is statistically significant as the p value calculated to be <0.05. From the above tables when compared with similar studies the amount of improvement in the JOA scores of the patient when compared to the pre-operative levels our study also shows significantly good improvement thereby providing a better clinical outcome for the patients undergoing the surgery

Table 13:

Kakadiya*et al*[12]	7.13±1.05
S.Fujibayashi*et al*[17]	5.2 +/- 3
Kei Watanabe *et al*[18]	10.3+/-3.72
Present study	7.28±0.44
Kakadiya*et al*[12]	9.48±1.08
S.Fujibayashi*et al*[17]	8.8+/-3
Kei Watanabe *et al*[18]	13.2+/-2.41
Present study	8.21±0.42

The mean Pre-Operative Disk height is 7.28±0.44. A significant improvement in disk height is seen at 1-month post-operative 8.19±0.41, at 1 year is 8.21±0.42. This observation is statistically significant as the p value calculated to be <0.05.

When we compare the results of our study with the others as seen above, a significant and good improvement in the disc height postoperatively and also its maintenance at end of 1 year thereby signifying maintenance of root decompression which matched with the clinical improvement of the patients showing an improved radiological improvement postoperatively.

The success of the fusion was our main agenda; with the above comparison we can observe that our study has provided with good results, however there were not good number of similar studies to compare with, either as they have not specified separately the grades of fusion or have used different criteria for assessing fusion thereby signifying the importance of this study and its need. In one of the studies on comparing the complications of TLIF procedure with our study showed. Complications are compared with our study.

Table 14:

	Dural tears	**Post-operative Ileus**	**Wound Infection**	**Recurrence of pain**	**Deficits**	**Pseudarthrosis**
AbdulSatar*et al*[19]	4.3%	7.6%	6.7%	5.7%	0.4%	5.7%
Present study	0	0	0	7.7%	0	5.1%

Conclusion

Lumbar Canal Stenosis is a severe debilitating disease with claudication pain and neurogical deficits leading to modification in the lifestyle of the patients thereby decreasing their quality of life. TLIF with bone graft only has revolutionized the treatment of these patients by allowing immediate rehabilitation and early return to their pre-morbid condition,free of symptoms and there by drastically improving their quality of life.

There is also a very significant improvement in the patients clinically, as seen with the Claudication Distance, ODI and JOA scores measured postoperatively. The assessment of fusion which was one of the main highlights of this study also showed

that the local bone graft used yielded very successful and satisfying results hence proving the importance of our procedure and its valiant advantages in being efficient and a cost-effective alternative to the general population. The maintenance of disc height and foraminal height postoperatively co-related well with the clinical improvement seen with the patients thereby adding to the success of the procedure in maintaining the root decompression. TLIF with autologous bone graft without cages for lumbar canal stenosis can successfully reduce the severe debilitating symptoms and provide a long term relief to the patients.

Conflict of Interest: None declared

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