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Functional outcome of transforaminal lumbar interbody fusion with localised bone graft

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Abstract
Background: Spinal disorders are a significant global health burden, with spondylolisthesis and degenerative disc disease being increasingly prevalent. While surgery is often necessary for these conditions, traditional methods involving intervertebral cages and iliac crest bone grafts can have limitations.
Objective: This study aimed to investigate the feasibility and efficacy of using local bone grafts obtained during surgery for cage-less lumbar interbody fusion.
Methods: A total of 36 patients with chronic low back pain underwent lumbar interbody fusion surgery using local bone grafts. Pre-operative and post-operative outcomes were assessed using the Visual Analog Scale (VAS) for pain and the Oswestry Disability Index (ODI) for function.
Results: The study demonstrated significant improvements in both VAS and ODI scores following surgery, indicating reduced pain and improved function. Additionally, the use of local bone grafts was associated with lower rates of complications compared to traditional bone graft sources.
Conclusion: This study suggests that local bone grafts can be a safe and effective alternative to traditional bone graft sources in lumbar interbody fusion. By eliminating the need for additional surgery to harvest iliac crest bone, this approach may reduce patient morbidity and improve overall outcomes.

Keywords: Lumbar interbody fusion, bone graft, local bone, spinal stenosis, spondylolisthesis

Introduction
Spinal disorders are a major cause of disability worldwide, affecting over a billion people [1]. Among all musculoskeletal disorders, spinal pain is the most common and the primary contributor to disability [1].
Spondylolisthesis and degenerative disc disease are becoming more common [2]. There has been a gradual increase in the incidence of spondylolisthesis and degenerative disc disease [2].
The majority of patients with spinal stenosis and degenerative spondylolisthesis can be managed effectively without surgery. Only a small percentage, approximately 10-15%, will need surgical treatment [15].
Many different treatments are available for degenerative disc disease and spondylolisthesis. These include surgical options like instrumented reduction and fusion, which can be done using various techniques such as posterolateral interbody fusion, oblique lumbar interbody fusion, 360° fusion, Anterior Lumbar Interbody Fusion (ALIF), Transforaminal Lumbar Interbody Fusion (TLIF), Posterior Lumbar Interbody Fusion (PLIF), Extreme Lateral Lumbar Interbody Fusion (XLIF).
The most widely used surgical method for treating degenerative lumbar disease is TLIF using pedicle screws [3].
TLIF treatment helps the spine by strengthening its weight-bearing part, restoring the height of the intervertebral disc, relieving pressure on the nerve roots, and improving the stability of the spinal segment [2].
Interbody fusion has been a common and safe procedure for many years, typically using intervertebral cages and bone graft taken from the iliac crest [2]. Intervertebral cages have several disadvantages, such as high cost, limited contact area for bone fusion, potential for end plate collapse, and the risk of the cage moving backward or Shifting [4].

AIC graft is considered ideal for spinal fusion because it is compatible with the body's tissues, doesn't cause an immune reaction, contains a large amount of cancellous bone and growth factors, and has pleuripotent cells that can help with bone formation and growth [5].

There have been reports of various problems with harvesting bone from the iliac crest, ranging from minor to severe [16]. These problems can include infections, pain at the donor site, blood clots, longer surgery times, and increased blood loss [5].

Our theory is that we can achieve successful fusion without using a cage or bone graft from the iliac crest. We believe that the bone pieces removed from the spinous process during surgery can be used to fill the intervertebral space [2].

We have not found any existing research on using localized bone grafts for cage-less lumbar interbody fusion. Therefore, this study aims to investigate this approach.

Materials and Methods

36 participants were selected for the study based on specific criteria. They were hospitalized at Sri Siddhartha Hospital and Research Centre between May 2022 & May 2024 for chronic low back pain and underwent spine surgery.

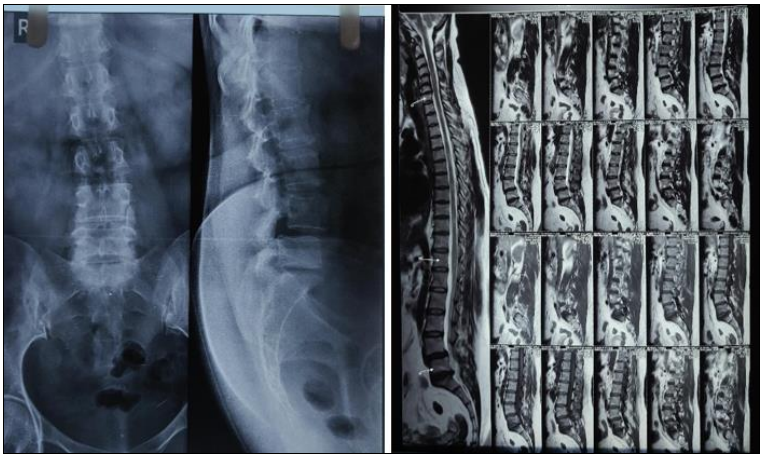
All participants had magnetic resonance imaging done within six months of surgery to confirm their diagnosis. They were also given conservative treatments like physical therapy and anti-inflammatory medications for at least three months. If their condition didn't improve with these treatments, they were recommended for surgery.

Inclusion Criteria

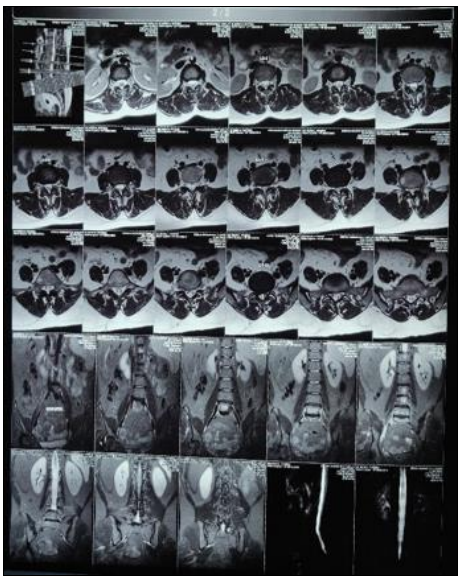
1. Lumbar intervertebral disc prolapsed with spinal canal stenosis.
2. Spondylolisthesis with disc degeneration.
3. Infective spondylodiscitis.

Exclusion Criteria

1. Cauda equina syndrome.
2. Paraplegia.
3. Tumors or malignancies of spine.
4. Spinal injuries including fracture.
5. Failed back syndrome.



(a) (b)



(c)

Fig 1: a) preoperative x-ray, b) preoperative MRI – saggital section, c) preoperative MRI – axial section

The clinical outcomes were measured by:

1. Visual analogue score (VAS) for low back pain
2. Oswestry disability index (ODI) for functional outcome and patient satisfaction after surgery

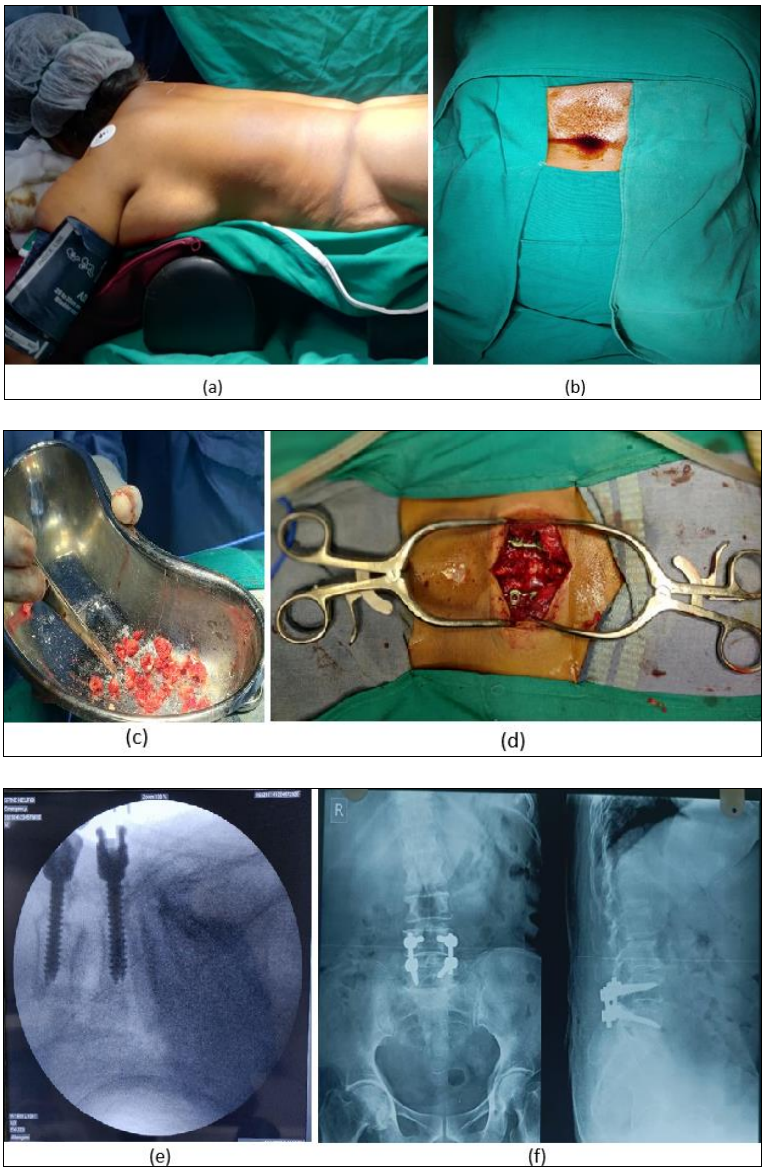


Fig 2: Intraoperative a) patient position, b) Draping and painting, c) bone graft preparation, d) screw fixation, e) intraoperative radiograph image, f) postoperative x-ray

Surgical Procedure

Patients were placed in a prone position under general anaesthesia and underwent surgery to access the posterior elements of the spine. Reduction screws were inserted into the slipped vertebra, and pedicle screws were inserted into the distal vertebra. The nerve roots were decompressed, and the disc space was prepared for fusion. Bone chips obtained from laminectomy and facetectomy were packed into the disc space after adding anti-biotic powder (Vancomycin 500 mg), and the screws were tightened after placing Harrington rod. Drains were removed after blood loss decreased. Patients were allowed to bend, sit, squat, and lift light weights after three months, and a brace was recommended for six weeks following surgery.

Results

Table 1: Mean age

N	Mean	Median	Std. Deviation	Minimum	Maximum
36	46.83	47.5	11.83	24.00	65.00

Table 1 shows age distribution among participants, age ranges from 24 years to 65 years with mean age of 46.83±11.83.

Table 2: Sex distribution

Sex	Frequency	Percent
Male	19	52.77
Female	17	47.22
Total	36	100.0

Table 2 in study shows sex distribution of participants underwent surgery, male preponderance (52.77%).

Table 3: Diagnosis

Diagnosis	Frequency	Percent
Lumbar disc herniation	23	63.88
Spondylolisthesis	7	19.44
Infective spondylodiscitis	6	16.66

Table 3 shows diagnosis of participants underwent surgery, out of 36 participants majority of participants suffered from lumbar disc herniation 23(63.88%), 7 (19.44%) participants diagnosed with spondylolisthesis and 6 (16.66%) participants diagnosed with infective spondylodiscitis.

Table 4: Pre and post op comparisons

Parameter		N	Mean	Std. Deviation	t-value	P-value*
VAS	Pre op	36	8.35	1.03	-18.12	<0.001
	6 month	36	2.84	1.05		
ODI	Pre op	36	47.18	7.55	-10.13	<0.001
	6 month	36	17.37	5.29		

* Paired t-test

Table 4 compared functional outcome using pre-operative and post-operative VAS and ODI. There is statistically significant (P <0.001) difference between preoperative and postoperative mean VAS (8.35±1.03 and 2.84±1.05 respectively), the statistically significant improvement seen in pre-operative and post-operative ODI (p<0.001) also, with mean ODI 47.18±7.55 and 17.37±5.29 respectively.

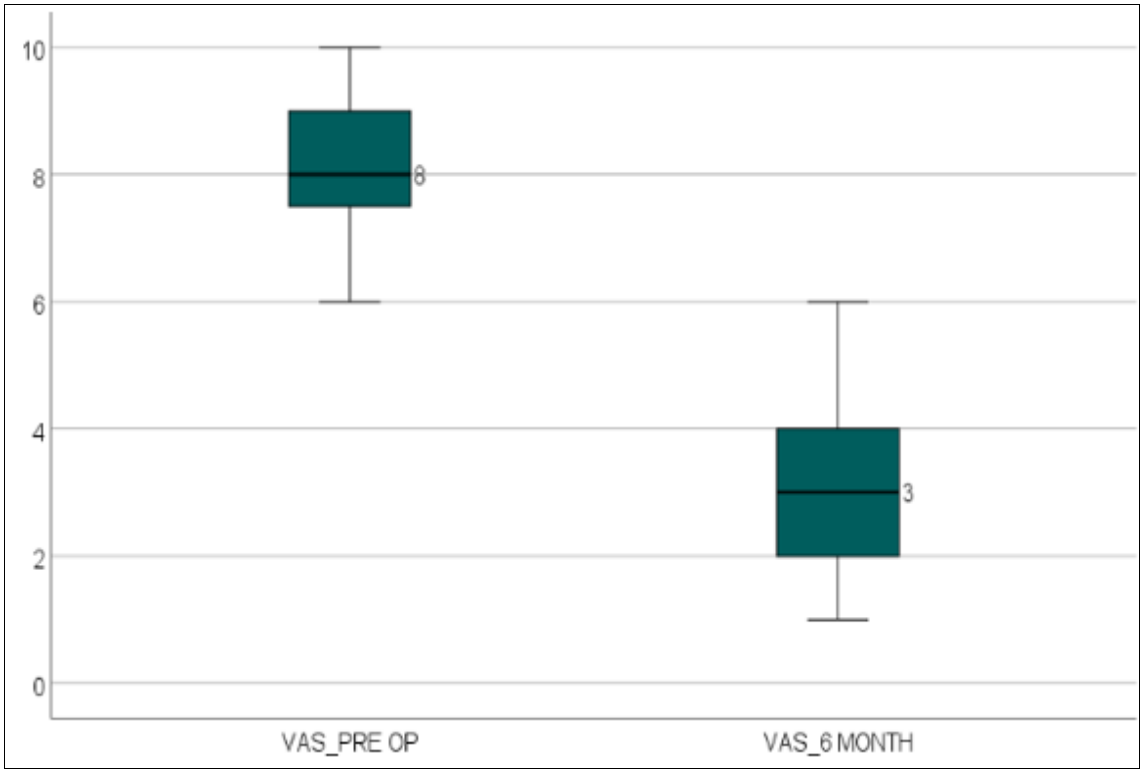


Fig 3: VAS SCORE

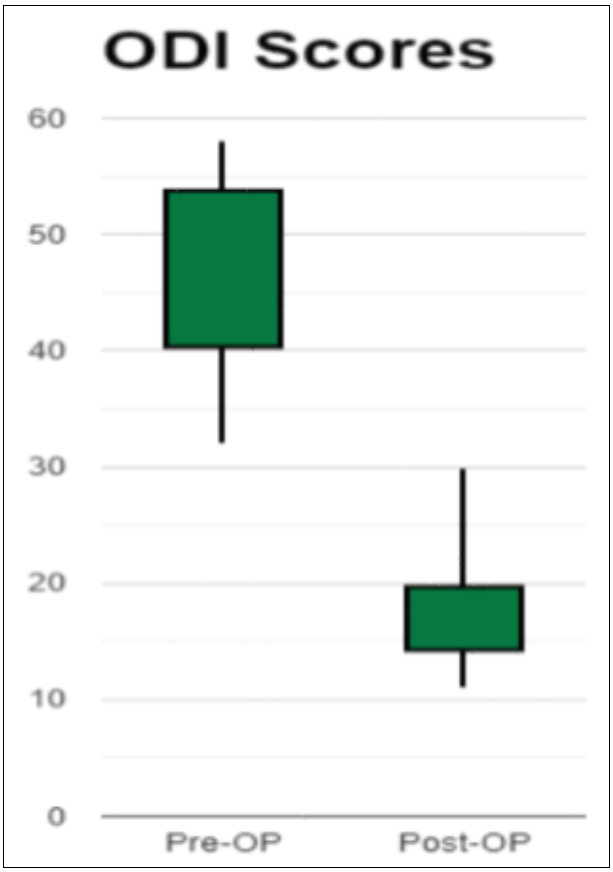


Fig 4: ODI

Table 5: Complications

Complications	Frequency	Percent
No complications	26	72.22
Dura rupture	1	2.8
Persistence of radicular pain	4	11.11
Spondylodiscitis	1	2.8
Stuck drain	1	2.8
Surgical site infection	3	8.33
Total	36	100.0

Table 5 shows complications, 10 participants (27.77%) in this study suffered from complications including 1 patient sustained dural rupture treated by keeping drain for longer duration and maintaining hydration, 3 participants suffered from surgical site infection healed by giving iv antibiotic, in 1 patient wound infection progressed to spondylodiscitis treated with long term iv antibiotics followed by oral antibiotic therapy, 1 patient's drain got stuck treated with re-exploration of surgical wound and removal of drain, 4 participants complains of persistence of radicular symptoms.

Discussion

The study examined 36 patients who had persistent low back pain despite conservative treatment. These patients were treated at the Department of Orthopaedics at Sri Siddhartha Medical College, Tumakuru. After surgery, the patients were followed up for six months and assessed for their functional outcomes using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores.

The use of bone grafts in posterior lumbar interbody fusion (PLIF) surgery has evolved since Cloward's initial report in 1967. Various bone graft sources, including autologous, allograft, and artificial bone, have been used in combination with different types of implants to enhance mechanical strength and promote biological healing. Autologous cancellous bone harvested from the iliac crest was once considered the ideal graft due to its superior bone formation properties. However, the associated donor site morbidity led to a search for alternative graft sources. Allograft and artificial bones have limitations in bone formation and carry risks like disease transmission [6-9].

Branch and colleagues conducted a study on 172 patients who underwent non-instrumented PLIF surgery using a technique that involved harvesting the en bloc spinous process and lamina. Approximately 75% of the participants achieved positive outcomes. This study demonstrated that local bone obtained from the spine can be a reliable bone graft source for PLIF surgery, even without using additional spinal instrumentation [10].

Zenya Ito and colleagues conducted a study comparing local bone grafts to iliac bone grafts for posterior lumbar interbody fusion. They found that both types of grafts resulted in similar fusion rates. However, the study also reported donor site morbidity in 19% of patients who received iliac bone grafts. This suggests that local bone grafts may be a more advantageous option, as they can achieve comparable results without the risk of donor site complications [11].

Abou-Madawi and colleagues conducted a study on 100 patients with single-level spondylolisthesis to compare the outcomes of using local autograft versus iliac crest bone graft in transforaminal lumbar interbody fusion (TLIF) surgery. They assessed pain levels using the VAS score and functional outcomes using the ODI score. Both groups showed significant improvements in pain and function after surgery. The VAS scores decreased from around 8 pre-operatively to around 3 post-operatively in both groups. Similarly, the ODI scores decreased from around 41 pre-operatively to around 13 post-operatively in both groups. These findings align with our study, which also demonstrated significant improvements in VAS and ODI scores after surgery [12].

Sengupta and colleagues conducted a study comparing the use of local bone grafts to iliac crest bone grafts (ICBG) in instrumented posterolateral lumbar fusion. They found that both groups experienced similar improvements in Oswestry Disability Index (ODI) scores, with approximately 32% and 36% improvement in the ICBG and local bone groups, respectively. While there was no significant difference in overall clinical outcomes between the two groups, the local bone group reported significantly less blood loss and a shorter hospital stay. This suggests that local bone grafts may be a more advantageous option due to these additional benefits [13].

Banwart and colleagues conducted a study to investigate complications associated with harvesting iliac crest bone grafts. They found that minor complications, such as numbness, prolonged wound drainage, and superficial infections, were relatively common, occurring in approximately 39% of cases. Major complications, including hematoma, wound infection, reoperation, and chronic pain, were less frequent, but still significant, affecting 10% of patients. These findings align with your study, which reported complications in 22.2% of participants. This suggests that donor site morbidity is a potential risk associated with using iliac crest bone grafts [14].

Conclusion

The study concluded that local bone obtained during surgery is a safe and effective option for bone grafts in lumbar interbody fusion. This approach can be used without the need for additional implants like cages.

Conflict of Interest

Not available.

Financial Support

Not available.

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