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Original Research Article

Outcome of Localised Bone Graft in the Instrumented Posterior Lumbar Interbody Fusion

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Abstract

Introduction: Pain in lower back is major factor leading to disability globally, affecting more than half a billion people worldwide. Among all musculoskeletal disorders degenerative spondylolisthesis and spinal stenosis most commonly requires intervention and about 10% to 15% of these patients needs surgical intervention. Many surgical methods are available, among these the most popular type of surgical treatment is posterior lumbar interbody fusion (PLIF) with pedicle screw fixation. Intervertebral cages and bone graft taken from the iliac crest have typically been employed in a safe and frequent manner for interbody fusion, as use of cage and iliac crest bone harvest reported to be associated with major or minor complications. Thus, Intervertebral space can be filled with bone pieces acquired intraoperatively from the spinous process alone.

Objective: To evaluate functional outcome post-surgery and assess complications associated with surgical procedure.

Material and Methods: 36 participants were chosen for the study based on inclusion and exclusion criteria from patients hospitalized to the Hospital and Research Centre, between September 2020 and November 2022 who complained of chronic low back pain and underwent spine surgery (PLIF with localised bone graft).

Result: In present study mean age found to be 45.78±11.75 years with male preponderance (66.7%), 25 (69.4%) participants diagnosed with lumbar disc herniation, 7 (19.4%) participants diagnosed with infective spondylodiscitis, and 4 (11.1%) participants diagnosed with spondylolisthesis. Mean VAS improved from 8.17±1.0 pre-operatively to 2.86±1.17 at 6th month follow-up, and mean ODI improved from 46.94±7.43 pre-operatively to 23.33±7.77 at 6th month follow up. Total of 8 (22.2%) participants suffered from major or minor complications treated accordingly.

Conclusion: Local bone obtained intraoperatively can be used as a viable source of bone graft without any need of cage for fusion of lumbar interbody.

Keywords: PLIF, Degenerative Disc Disease, Spondylolisthesis, Lumbar Spine.

Introduction

Disorders of the musculoskeletal system are common and the main cause of disability[1], Among all musculoskeletal disorders, pain originating from spinal disorders is the most common and the primary cause of disability globally, having an impact on more than a billion people worldwide.[1]

Spondylolisthesis and degenerative disc disease incidences have been gradually rising in recent years [2].

The vast majority of these patients benefit from nonoperative care and won't need surgery. Only 10 to 15 percent of those with spinal stenosis and degenerative spondylolisthesis eventually need surgical management[15].

Numerous treatment options have been recommended for the treatment of degenerative disc disease and spondylolisthesis. Treatment options include instrumented reduction and fusion (with or without cage) by means of any of the following techniques: Posterlateral interbody fusion, Oblique lumbar interbody fusion, Anterior Fusion with Posterior Fusion (360° fusion), Anterior Lumbar Interbody Fusion (ALIF), Transforaminal Lumbar Interbody Fusion (TLIF), Posterior Lumbar Interbody Fusion (PLIF), Extreme Lateral Lumbar Interbody Fusion (XLIF).

PLIF using pedicle screws is the most frequently used surgical technique to treat degenerative lumbar disease [3].

The PLIF treatment supports the anterior spinal column by strengthening the weight-bearing axis, restoring intervertebral disc height, decompressing nerve roots, and enhancing segmental stability [2].

For years, interbody fusion has normally been performed safely and often using intervertebral cages and bone graft from the iliac crest (AIC) [2].

As is widely known, intervertebral cages have a number of drawbacks, including significantly higher costs, a limited amount of contact space for bone fusion, end plate collapse, cage retropulsion and migration [4].

AIC graft has been regarded as ideal for spinal fusion due to its histocompatible and non-immunogenic properties, larger amounts of cancellous bone, growth factors, and pleuripotent cells linked to osteoinduction, osteogenesis, and osteoconduction [5].

There have been reports of significant or mild problems with iliac crest bone harvest ranging from 1% to 39% [16], including an increased risk of infection, pain at donor site, hematoma formation, longer operating time, and increased loss of blood.[5]

Our theory that adequate fusion can be achieved without the requirement of a cage and ICBG, and intervertebral space can be filled with only the bone pieces that were intraoperatively removed from the spinous process [2].

To our best knowledge, Studies on the use of a localised bone graft for fusion of lumbar interbody without a cage are not yet available, hence this study.

Materials and Methods

36 participants were chosen for the study based on inclusion and exclusion criteria from patients hospitalized to the Sri Siddhartha Hospital and Research Centre, Agalkote, Tumakuru between September 2020 and November 2022 who complained of chronic low back pain and underwent spine surgery.

All participants underwent magnetic resonance imaging within six months of

surgery to confirm the diagnosis, and they were treated with conservative measures like physical therapy and anti-inflammatory medications for at least three months before being advised to undergo surgery if they did not improve with these measures.

Inclusion

- Lumbar intervertebral disc prolapsed with spinal canal stenosis.
- Spondylolisthesis with disc degeneration.
- Infective spondylodiscitis.

Exclusion

- Cauda equina syndrome.
- Paraplegia.
- Tumors or malignancies of spine.
- Spinal injuries including fracture.
- Failed back syndrome.

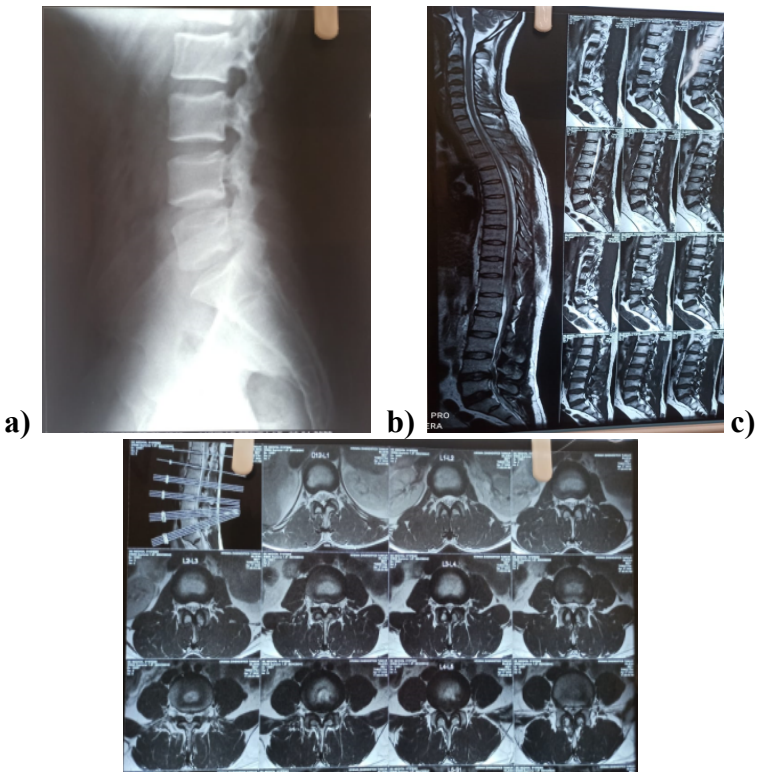

Figure 1: a) preoperative x-ray, b) preoperative MRI – saggital section, c) preoperative MRI – axial section

Clinical outcome parameters include[12]

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

Surgical procedure

Under general anaesthesia, participants positioned prone on a suitable spinal frame, and a standard posterior midline incision was performed. The spinous process and both laminae were exposed by laterally retracting bilateral paravertebral muscles till the outer edge of facets and facet joint, entry points made and pedicle screws fixed, spinous process resected using unblock method, laminotomy done up to facet joint and pars removed from both sides, cords retracted, complete discectomy with removal of the endplate cartilages performed from both vertebrae, localised bone graft prepared by cleaning of all soft tissue attachments added with antibiotic powder (vancomycin 250 mg) inserted to intervertebral space, pedicle screws connected with Harrington rod, wound closure done with drain.

Metal work position assessed by intraoperative radiography.

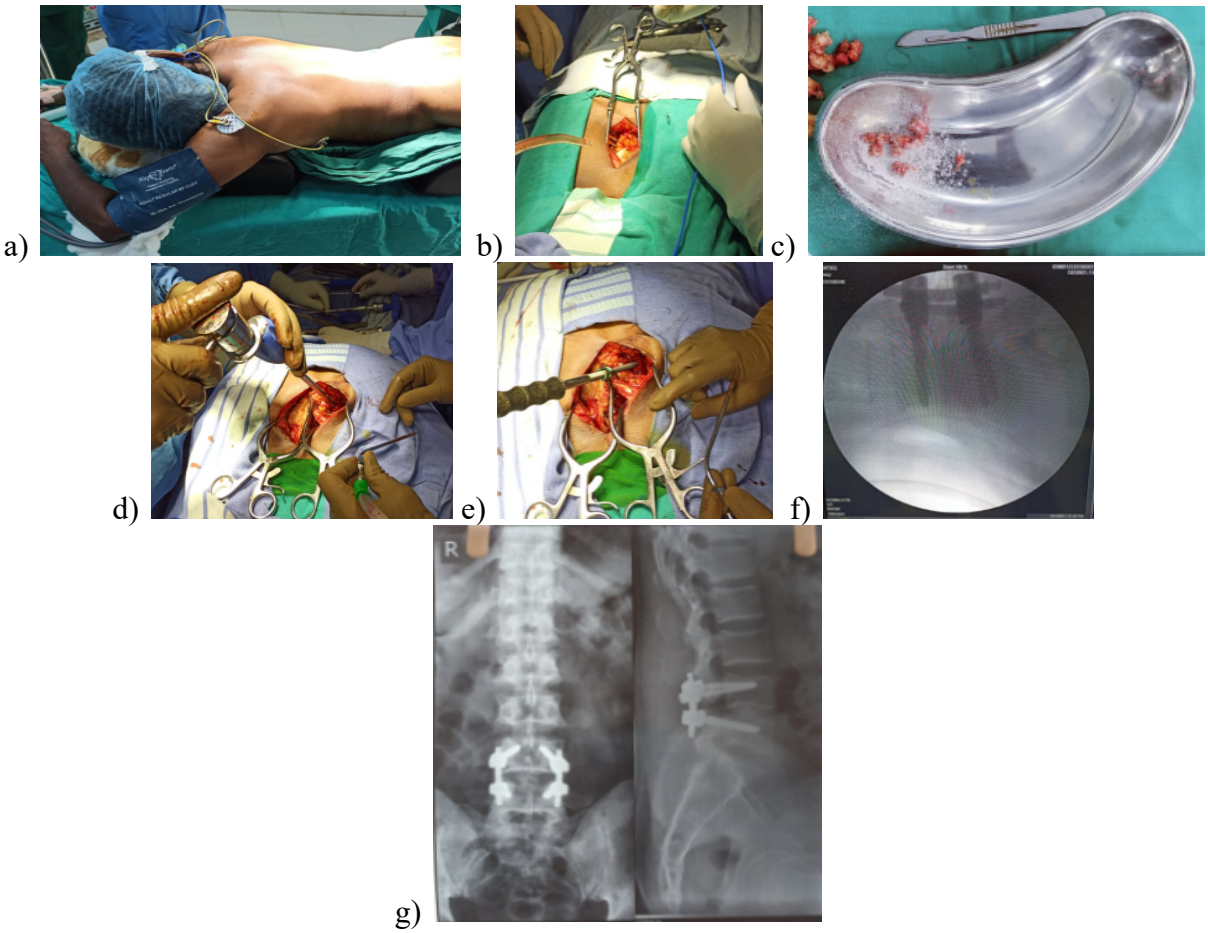

Figure 2: intraoperative a) patient position, b) soft tissue dissection, c) bone graft preparation, d) entry point for screw fixation, e) screw fixation, f) intraoperative radiograph image, g) postoperative x-ray.

Results

Table 1: Mean age

N	Mean	Median	Std. Deviation	Minimum	Maximum
36	45.78	45.50	11.75	23.00	65.00

Table 1 shows age distribution among participants, age ranges from 23 years to 65 years with mean age of 45.78±11.75.

Table 2: Sex distribution

Sex	Frequency	Percent
Male	24	66.7
Female	12	33.3
Total	36	100.0

Table 2 in study shows sex distribution of participants underwent surgery, male preponderance (66.7%).

Table 3: Diagnosis

Diagnosis	Frequency	Percent
Lumbar disc herniation	25	69.4
Spondylolisthesis	4	11.1
Infective spondylodiscitis	7	19.4

Table 3 shows diagnosis of participants underwent surgery, out of 36 participants majority of participants suffered from lumbar disc herniation (69.4%), 4 participants diagnosed with spondylolisthesis and 7 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	8.17	1.00	20.593	<0.001
	6 month	36	2.86	1.17		
ODI	Pre op	36	46.94	7.43	12.583	<0.001
	6 month	36	23.33	7.77		

** 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 (8.17±1.0 and 2.86±1.17 respectively), the statistically significant improvement seen in pre-operative and post-operative ODI (P<0.001) also, with mean ODI 46.94±7.43 and 23.33±7.77 respectively.

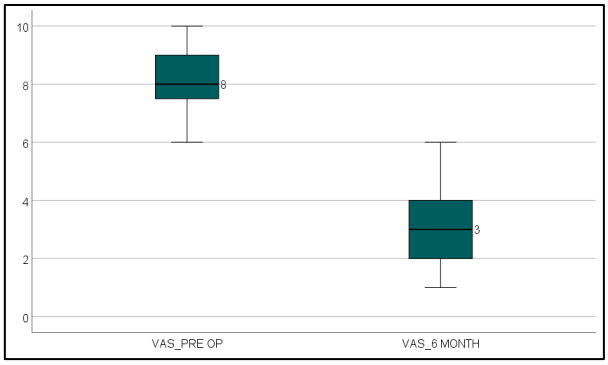

Figure 3: VAS

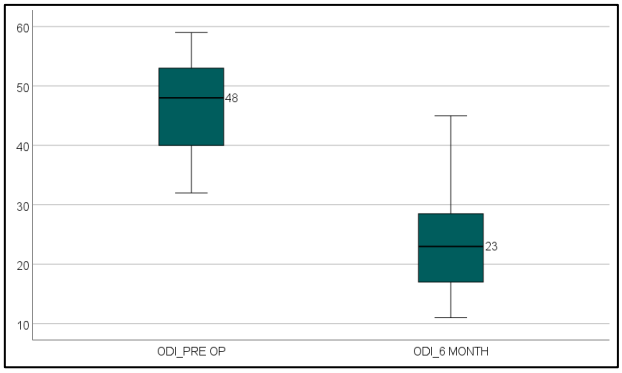

Figure 4: ODI

Table 5: Complications

Complications	Frequency	Percent
No complications	28	77.8
Dura rupture	1	2.8
Persistance of radicular pain	3	8.3
Spondylodiscitis	1	2.8
Stuck drain	1	2.8
Surgical site infection	2	5.6
Total	36	100.0

Table 5 shows complications, Eight participants (22.2%) in this study suffered from complications including 1 patient sustained dural rupture treated by keeping drain for longer duration and maintaining hydration, 2 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, 3 participants complains of persistence of radicular symptoms .

Discussion

The present study conducted on 36 participants, presented to department of orthopaedics Sri Siddhartha medical college, Tumakuru with complains of low back ache not subsided with conservative plan of management, followed up at 6th month postoperatively and evaluated for functional outcome using VAS and ODI score.

Since Cloward[6] reported the PLIF techniques, various bone graft sources have been tried by different authors, mechanical strength and biological healing properties are major determinants for graft selection, several types of implants (cages) have been used to supplement grafts to improve mechanical toughness. Such an implant was the Brantigan I/F cage, autologous cancellous bone from the iliac crest was used as graft.[7-9] and was considered ideal. However, problems of donor site morbidity are associated. Allograft and artificial bones provide poor ability for bone formation, and there is a risk of transmission of blood-borne disease. The usage of local bone has been mentioned by a number of authors.

Branch et al.[10] demonstrated a method of using the en bloc spinous process and lamina in non-instrument PLIF, with about 75% (129 of 172 participants) attaining positive outcomes. They did not perform any spinal instrumentation, and their outcomes were quite good and comparable with other sources of bone graft, showing that local bone obtained can be used as a reliable bone graft source.

According to a study by Zenya Ito et al.[11], both the local bone group and the iliac bone group produced results in fusion that were nearly identical. The study found that local bone grafting is just as effective for posterior lumbar interbody fusion at a single level however donor site morbidity reported in 19% of the cases of autologous iliac bone group.

Abou-Madawi et al.[12] did a comparison analysis on 100 patients diagnosed with single level spondylolisthesis, to compare the outcome of local autograft (group I) versus iliac crest bone graft (group II) stand-alone transforaminal lumbar interbody fusion (TLIF) using VAS and ODI score. The VAS reduced from 8.0±3.1 preoperatively to 3.4±2.9 postoperatively in group I and from 8.0±3.2 preoperatively to 3.6±2.6 postoperatively in group II. The ODI reduced from 41.4±8.0 preoperatively to 12.3±7.0 postoperatively in group I and from 39±9.0 preoperatively to 13±8.0 postoperatively group II, which is comparable with our study showing improvement in pre-operative and post-operative VAS from 8.17±1.0 to 2.86±1.17 and ODI score from 46.94±7.43 to 23.33±7.77 at 6th month follow up.

In a retrospective study conducted by Cakir et al.[2] to compare the outcomes of using synthetic bone graft (group A) versus autograft (group B) obtained from the spinous process in patients underwent PLIF observed that pre-operative and post-operative VAS improved from 9.3 ± 1.0 to 3.1 ± 1.4 in group A, and from 8.0 ± 1.1 to 3.6 ± 0.3 in group B, whereas ODI score improved from 61.7 ± 4.4 to 34.1 ± 1.4 in group A, and from 60.8 ± 8.0 to 37.4 ± 4.3 in group B at the 6 month follow-up. Bony union reported higher in group A at both 6 months and 5 years, but difference found

to be insignificant when compared. Moreover, no significant difference found in maintaining the intervertebral disc heights between the two groups and concluded that fusion of the intervertebral space can be successfully achieved, and intervertebral height can be maintained by using autograft from the patient's spinous processes.

A study comparing use of using local bone versus autogenous iliac crest bone graft (ICBG) in instrumented posterolateral lumbar fusion conducted by Sengupta et al.[13]observed the mean improvement in the ODI was 32% for ICBG group and 36% for the local bone group. In the two groups, there was no obvious difference in the overall clinical result. The local bone group reported much reduced blood loss and hospitalisation.

In a study conducted by Banwart et al.[14] to analyze donor site complications in iliac crest bone graft harvest reported that minor complications were more common (39%) and included dysesthesia, prolonged wound drainage, broken drains, and superficial infection, Major complications were reported in 10% of cases and included hematoma formation, wound infection, reoperation, unsightly scar, and chronic pain restricting physical function, which is comparable to our study showed complication in 8 participants (22.2%).

Conclusion

This study concluded that local bone obtained intraoperatively is a safe and effective source of bone graft and can be used for lumbar interbody fusion without any need of cage.

References

1. Costanzo G, Misaggi B, Ricciardi L, AlEissa SI, Tamai K, Alhelal F, Alqahtani Y, Alsobayel HI, Arand M, Balsano M, Blattert TR. SPINE20 recommendations 2021: spine care for people's health and prosperity. European Spine Journal. 2022 Apr 7:1-0.
2. Cakir T, Yolas C. Synthetic bone graft versus autograft obtained from the spinous process in posterior lumbar interbody fusion. Turk Neurosurg. 2021 Jan 1;31(2):199-205.3.
3. Ko S, Jun C, Nam J. Comparison of Fusion Rate and Functional Outcome Between Local Cancellous Bone Plus Demineralized Bone Matrix and Local Bone in 1-Level Posterior Lumbar Interbody Fusion. Clinical Spine Surgery. 2022 Mar 31:10-97.
4. Tuchman A, Brodke DS, Youssef JA, Meisel HJ, Dettori JR, Park JB, Yoon ST, Wang JC. Iliac crest bone graft versus local autograft or allograft for lumbar spinal fusion: a systematic review. Global spine journal. 2016 Sep;6(6):592-606.
5. Tavares WM, de França SA, Paiva WS, Teixeira MJ. A systematic review and meta-analysis of fusion rate enhancements and bone graft options for spine surgery. Scientific reports. 2022 May 9;12(1):1-9.
6. Cloward RB. The treatment of ruptured intervertebral discs by vertebral body fusion: report of 750 cases. J Neurosurg.1953; 10:154–168.
7. Brantigan JW, Steffee AD, Lewis ML, et al. Lumbar interbody fusion using the Brantigan I/F cage for posterior lumbar interbody fusion and the variable pedicle screw placement system: two-year results from a Food and Drug Administration investigational device exemption clinical trial. Spine. 2000; 25:1437–1446.
8. Brantigan JW, Steffee AD. A carbon fiber implant to aid interbody lumbar fusion. Two-year clinical results in the first 26 patients. Spine. 1993;18: 2106–2117.
9. Brantigan JW, Steffee AD, Geiger JM. A carbon fiber implant to aid interbody lumbar fusion mechanical testing. Spine. 1991;16:s277-s282.

10. Branch CL, Branch CLJ. Posterior lumbar interbody fusion with the keystone graft: Technique and results. Surg Neurol. 1987; 27:449–454.
11. Ito Z, Imagama S, Kanemura T, Hachiya Y, Miura Y, Kamiya M, Yukawa Y, Sakai Y, Katayama Y, Wakao N, Matsuyama Y. Bone union rate with autologous iliac bone versus local bone graft in posterior lumbar interbody fusion (PLIF): a multicenter study. European Spine Journal. 2013 May;22(5):1158-63.
12. Abou-Madawi AM, Ali SH, Abdelmonem AM. Local autograft versus iliac crest bone graft PSF-augmented TLIF in low-grade isthmic and degenerative lumbar spondylolisthesis. Global Spine Journal.2022 Jan;12(1):70-8.
13. Sengupta DK, Truumees E, Patel CK, Kazmierczak C, Hughes B, Elders G, Herkowitz HN. Outcome of local bone versus autogenous iliac crest bone graft in the instrumented posterolateral fusion of the lumbar spine. Spine. 2006 Apr 20;31(9):985-91.
14. Banwart JC, Asher MA, Hassanein RS. Iliac crest bone graft harvest donor site morbidity: a statistical evaluation. Spine 1995; 20:1055–60.
15. Vibert BT, Sliva CD, Herkowitz HN. Treatment of instability and spondylolisthesis: surgical versus nonsurgical treatment. Clinical Orthopaedics and Related Research®. 2006 Feb 1; 443:222-7.
16. Ito Z, Matsuyama Y, Sakai Y, Imagama S, Wakao N, Ando K, Hirano K, Tauchi R, Muramoto A, Matsui H, Matsumoto T. Bone union rate with autologous iliac bone versus local bone graft in posterior lumbar interbody fusion. Spine. 2010 Oct 1;35(21): E1101-5.