Received: 3 March 2023 | Revised: 6 July 2023 | Accepted: 7 August 2023

DOI: 10.1002/ccr3.7847

CASE REPORT

Clinical Case Reports Open Access WILEY

Anterior graft migration in posterior lumbar interbody fusion: A case report and literature review

Masanori Hashimoto[1,2] | **Hirohito Hirata**[1] | **Masatsugu Tsukamoto**[1] | **Yoshihara Tomohito**[1] | **Masaaki Mawatari**[1] | **Tadatsugu Morimoto**[1]

[1]Department of Orthopedic Surgery, Faculty of Medicine, Saga University, Saga, Japan

[2]Department of Orthopedic Surgery, Faculty of Medicine, Teikyo University, Tokyo, Japan

Correspondence
Masanori Hashimoto, Department of Orthopedic Surgery, Faculty of Medicine, Saga University, 1-1, 5-chome, Nabeshima, Saga-shi, Saga, Japan; Department of Orthopedic Surgery, Faculty of Medicine, Teikyo University, 2-11-1, Kaga, Itabashi-ku, Tokyo, Japan.
Email: kmu_shinten@yahoo.co.jp

Key Clinical Message

Spine surgeons should be aware of the possibility of anterior displacement of the grafted bone during PLIF and the potential for severe complications that may arise because of such displacement so that preparations can be made for a proper response.

Abstract

We report two cases of anterior displacement of the grafted bone after posterior lumbar interbody fusion (Graphical Abstract A-D). The patients did not require additional surgery. The anterior migration of grafted bone or cage can cause damage to anterior organs and blood vessels. Therefore, a careful surgical procedure is necessary.

KEYWORDS

allograft bone, complications, deep vein thrombosis, graft migration, posterior lumbar intervertebral body fusion, vascular injury

1 | INTRODUCTION

Posterior lumbar interbody fusion (PLIF)/transforaminal lumbar interbody fusion (TLIF) are globally recognized surgical techniques, with documented reports on their therapeutic efficacy and safety.[1]

These surgeries are aimed at bony fusion between vertebrae; therefore, rare complications can arise from spine surgery. This can cause damage to adjacent visceral structures such as the intestines and blood vessels during disc curettage and cage/bone grafting.[2]

Anterior graft migration in lumbar interbody posterior fusion surgery is usually an unexpected intraoperative finding due to its rarity and subtle imaging findings. This can lead to poor decision-making and inaccurate prognosis.

The purpose of this paper is to present such cases, and review the literature, in addition to raising awareness and a high index of suspicion for the prevention, early detection, and treatment of this condition, among spine surgeons.

2 | CASE PRESENTATION

2.1 | Case 1

A 71-year-old woman complained of L5 radiculopathy due to right L5/S intervertebral foraminal stenosis, and L5–S PLIF was planned. After discectomy, autogenous bone chips were inserted into the disc space. When the autogenous bone was inserted into the disc space with

an impactor, the autogenous bone migrated anteriorly. We noticed the migration using an X-ray fluoroscope; thus, the bone grafting was stopped (Figure 1A). After the bone graft was inserted, an intraoperative plain computed tomography (CT) scan was performed to confirm the position of the displaced bone graft. Given that there was no evidence of compression to the vasculature, the anteriorly displaced grafted bone was not removed. A postoperative contrast-enhanced CT scan was performed immediately after the surgery, and we reconfirmed that there was no compression of major blood vessels, as was the case intraoperatively (Figures 1B–D). The patient was also examined by a vascular surgeon and was placed under observation. The patient's L5 radiculopathy disappeared after surgery. The patient was followed up with a plain CT scan and a medical examination 3 months after surgery. There were no radiological changes or clinical signs related to damage to the major vessels due to the grafted bone.

2.2 | Case 2

A 79-year-old woman was scheduled for L4–L5 PLIF for spinal canal stenosis due to L4 degenerative spondylolisthesis. After discectomy, autogenous bone chips and a cage were inserted bilaterally into the disc space. Intermittent claudication and gluteal pain were quickly alleviated by surgery. A plain CT scan during the first postoperative week showed the anterior migration of the grafted bone; hence, a contrast-enhanced CT scan was performed to confirm the vascularity, but there was no obvious compression by the grafted bone (Figure 2). After consulting with a vascular surgeon, the patient was placed under observation. The patient is still under observation, and there are no aneurysms or deep vein thrombosis. A plain CT at 1.5 years postoperatively showed a reduction of the anteriorly migrated grafted bone (Figure 3).

3 | MATERIALS AND METHODS

In this study, we systematically searched and reviewed the literature for reported cases of anterior graft migration in the posterior lumbar intervertebral body fusion and collected individual patient data.

Relevant peer-reviewed articles published in the English language (as of January 2022) were retrieved from PubMed and Google Scholar. The reference lists of publications identified via the database search were also screened.

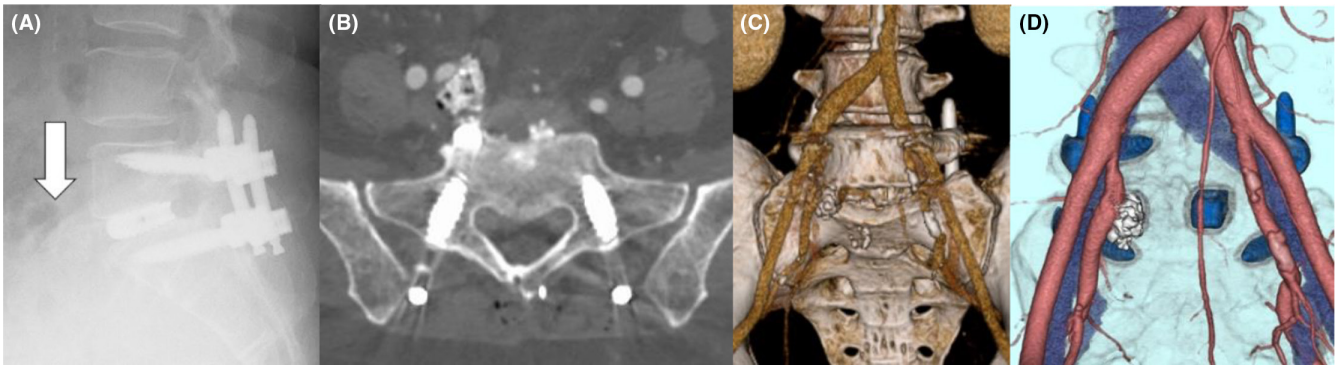

FIGURE 1 Postoperative lumbar lateral X-ray (A) and CT angiography (B), 3D CT VRT (C, D) of case 1 showed the displaced grafted bone in the anterior aspect of the vertebral body. The open arrow is pointing to anteriorly displaced grafted bone. We confirmed the vessels and the grafted bone with contrast-enhanced CT (B), but there was no compression drainage of the vessels.

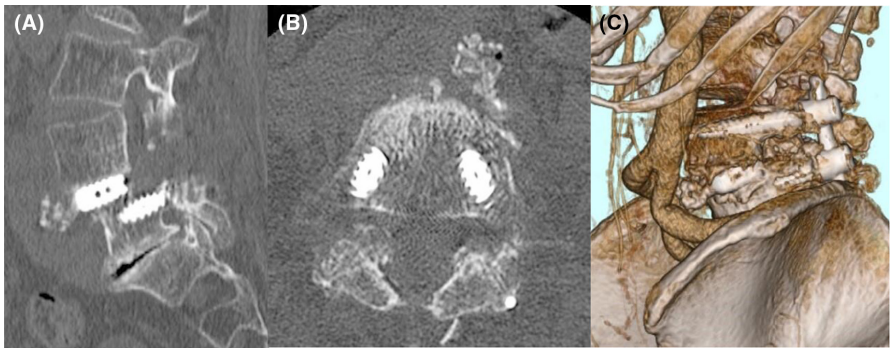

FIGURE 2 Postoperative plain CT (A: sagittal image, B: axial image) and 3D CT VRT (C) of case 2 showed anterior migration of the grafted bone, but there was no obvious compression of the vessels by the grafted bone (Figure 2): open arrow, graft bone.

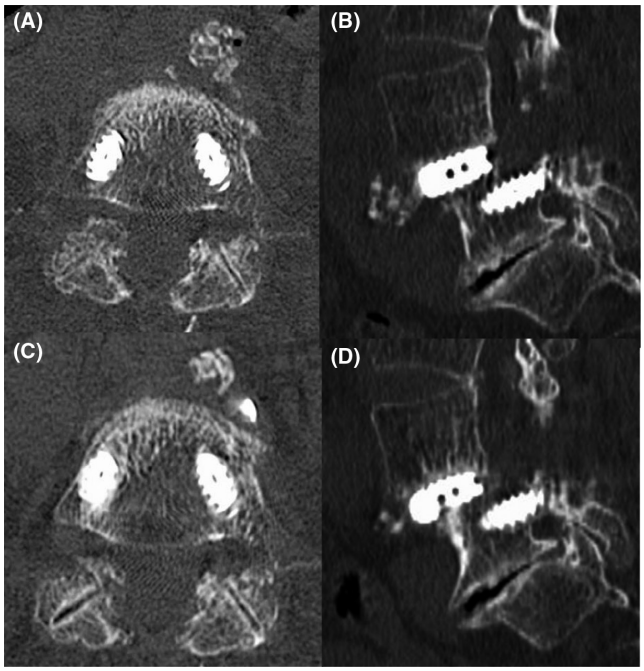

FIGURE 3 Postoperative plain CT (A: axial image, B: sagittal image) of case 2 showed a displaced grafted bone anterior to the lumbar vertebral body. At 1.5 years Postoperative plain CT (C: axial image, D: sagittal image) of case 2 showed that the allograft bone had reduced.

4 | RESULTS

A total of 26 cases (average age, 59.5 years [range, 14–82 years]) of anterior graft migration during spinal surgery were identified in thirteen articles (Table 1).[2-13]

The patient background mainly was women (women: 18 cases, men: 8 cases) and slightly more elderly (age > 65 years: 15 cases; age < 65 years: 11 cases). Cage transposition was occurred in 22 cases, and the transposition of the bone graft was occurred in 4 cases.

Three of the four cases of bone graft migration resulted in serious complications and required surgery. Fourteen cases of the 22 cases of anterior cage migration required surgery, and 8 cases required conservative treatment. Anterior dislocation of the bone graft tended to lead to surgery.

5 | DISCUSSION

We presented two cases of anterior migration of grafted bone during PLIF and TLIF.

From the 26 cases in Table 1, it was also found that the majority of cases occurred in the lower lumbar spine (12 in L4/5 and 13 in L5/S). Maeno et al. determined that one factor is that the anterior decubitus ligament of L5–S is particularly thin anatomically.[3] The higher olisthesis is too fragile to anteriorly support tissues such as the anterior longitudinal ligament and annular fibers, and the bony floor between the upper and lower vertebrae is narrowed.[3] In addition, the vertebral body shape of L5 is usually trapezoidal, and the tilted pelvis with the upper plate edge of S1 is considered another factor.[2]

In other words, in the lower lumbar spine, anatomical reasons such as weakness of the supporting tissues and pelvic tilt are thought to be the cause of the occurrence. Our cases also occurred in the lower lumbar spine, and the same reasons were considered.

Another complication that has not been reported with grafted bone but can occur with the anterior dislocation of the grafted bone is described.

The fusion rate of autologous iliac crest grafts in lumbar spine surgery has been reported to be 75% to 96%.[14] In the present cases, the grafted bone was resorbed without fusion in both cases, but it is not clear what the outcome of a displaced grafted bone would be. In some cases, the grafted bone may not be absorbed and may fuse with an anteriorly displaced grafted bone in the anterior aspect of the lumbar vertebral body. Einar et al. reported that osteophytes in the anterior aspect of the lumbar vertebral body perforated the abdominal aorta and created a pseudoaneurysm.[15] The same thing can happen when an anteriorly displaced grafted bone fuses in the anterior aspect of the lumbar vertebral body; therefore, careful long-term follow-up is necessary.

During spine surgery, the spinal cord and vascular structures are close to each other. Because of these locational relations, severe complications can occur.

In particular, anterior graft migration can lead to serious complications that can damage blood vessels and bowels. Most reports are of posterior migration, and reports of anterior migration are rare.[2]

Both of our cases were case reports of anterior migration, which is both rare and could lead to serious complications.

Serious complications from anterior dislocation of a bone graft and cage include bowel injury and vascular injury (including deep vein thrombosis). Each of these will be discussed. Although there were no such symptoms in these cases, they can occur late, and we must be aware of them.

5.1 | Bowel injury

Garg et al. reported a case of sigmoid colon perforation due to the dislocation of a bone graft on postoperative day 4 after TLIF for L4–L5 lumbar spinal stenosis.[4] Ruf et al. reported a perforation of the sigmoid colon due to spacer dislocation 4 years after the endoscopic insertion

TABLE 1 Studies reporting anterior graft migration.

Graft/ Cage	Author	Age (years.), Sex	Diagnosis	Migration level	Complication	Treatment
Graft bone	Cakmak[5]	26/M	Spondylolisthesis	L4-S1	Colon perforation	Excision
	Garg[4]	35/F	LSS	L4/5	Sigmoid colon perforation	Excision
	Yoshimoto[13]	83/F	Isthmic spondylolisthesis	L5/S	Deep vein thrombosis	Excision
	Maeno[3]	52/M	LDH	L5/S	Hydroxyapatite	Observation
	In this study					
	Case 1	71/F	Intervertebral foramen stenosis	L5/S	None	Observation
	Case 2	79/F	Spondylolisthesis	L5/S	None	Observation
Cage	Xu[2]	65/F	Spondylolisthesis	L5/S	Left femoral nerve injury following cage extraction	Extraction
	Proubasta[7]	30/ M	Degenerative disc disease	L5/S	Compressed major vessels	Extraction
	Pawar[9]	55/ F	Infective spondylodiscitis	L3/4	IVC injury	Observation
	Oh[10]	51/M	Isthmic spondylolisthesis ,	L4/5	Severe low back and left leg pain for 7 days	Extraction
	Ariyoshi[11]	74/F	DLS	L4/5	IVC injury	Extraction
	Kumar[12]	80/F	DLS	L5/S	None	Observation
	Maeno[3]	70/F	DLS	L5/S	None	Observation
		69/F	DS	L4/5	None	Observation
	Ceylan[6]	60/F	LSCS	L5/S	None	Observation
		55/F	LSCS	L5/S	None	Observation
		53/F	LSCS	L4/5	None	Observation
	Murase[8]	64/F	DLS	L2/3	None	Observation
		75/M	LSCS	L5/S	None	Observation
		81/F	DLS	L4/5	None	Extraction
		56/F	DLS	L3/4	None	Extraction
		80/M	LDH	L4/5	None	Extraction
		65/F	DLS	L2/3	None	Extraction
		72/F	DS	L4/5	None	Extraction
		67/M	LSCS	L4/5	None	Extraction
		67/F	DLS	L5/S	IVC compression	Extraction
		64/F	DLS	L4/5	The right common iliac vein compression	Extraction
		85/M	LDH	L4/5	IVC compression and deep vein thrombosis.	Extraction
		73/F	DLS	L4/5	IVC injury	Extraction

Abbreviations: DLS, Degenerative lumbar scoliosis; DS, Degenerative spondylolisthesis; IVC, Inferior Vena Cava; LDH, Lumbar disc hernia; LSCS, Lumbar spinal canal stenosis.

of a spacer anteriorly and instrumentation posteriorly.[16] Cakmak et al. reported a case of cecum perforation 1 year after L5–S1 posterior intervertebral fusion with a femoral graft via an anterior approach.[5] Bowel perforation can lead to peritonitis, which can lead to death if therapeutic intervention is delayed. Therefore, early detection is necessary.[17] All of the authors have avoided serious consequences by taking frequent postoperative X-rays to detect them early.

5.2 | Vascular injuries

Vascular injuries during spine surgery are rare, with aortic rupture occurring in 0.01% and inferior vena cava rupture in 0.02%.[18,19]

The retroperitoneum is a complex structure with many vessels and nerves and has been studied extensively. It is possible to cause damage to important structures, especially in conditions with anatomical variation and deformity.[2]

Specifically, the left common iliac artery runs just medial to the L4–L5 disc and is the most commonly injured vessel in lumbar disc herniation.[6]

When performing surgery, we must be aware that the vessel runs just medial to the disc.

This report discusses vascular-related complications that can arise in spinal surgery because of the displacement of cages or grafted bones. These complications include vascular injury and deep vein thrombosis. When a cage or bone graft is displaced anteriorly, there is a risk of injuring large blood vessels, thus potentially leading to massive bleeding. In such cases, it is recommended to remove the cage as soon as possible after surgery. However, some reports suggest that surgery may not be necessary in cases of anterior cage displacement because conservative therapy may be sufficient if the displaced cage is far from the site of the large vessels. Therefore, early postoperative contrast-enhanced CT should be performed to determine the position of the displaced cage relative to the large vessels.

Deep vein thrombosis can also occur when a displaced graft or cage compresses a blood vessel, and this can happen not only in the early postoperative period but also over a longer period of time if there is further displacement. Therefore, monitoring any anterior displacement of the grafted bone or cage is essential, such as regular ultrasound and contrast-enhanced CT every 6 to 12 months until the displaced graft is firmly fused. In cases wherein the position of the grafted bone and cage is confirmed and there is no obvious compression of the large vessels, careful follow-up is considered effective. However, if the grafted bone or cage appears to be directly compressing the blood vessel, surgical treatment to remove the compressing graft or cage may be necessary.

Overall, the position of the displaced graft or cage in relation to the large vessels greatly influences the treatment plan, thus highlighting the importance of obtaining early imaging studies and taking appropriate action in cases of vascular injuries.

6 | CONCLUSION

Spine surgeons need to be aware of the possibility of anterior dislocation of the allograft during posterior lumbar intervertebral body fusion. Complications should be minimized via careful surgical techniques and knowledge of possible complications. In particular, intestinal and vascular injuries are serious complications and must be avoided. For this reason, it is necessary to watch for changes in vital signs, abdominal pain, and other symptoms.

If complications occur, prompt detection and treatment should minimize long-term sequelae.

AUTHOR CONTRIBUTIONS

Masanori Hashimoto: Writing – original draft. **Hirohito Hirata:** Writing – review and editing. **Masatsugu Tsukamoto:** Writing – review and editing. **Yoshihara Tomohito:** Writing – review and editing. **Masaaki Mawatari:** Project administration. **Tadatsugu Morimoto:** Project administration.

ACKNOWLEDGMENTS

None.

FUNDING INFORMATION

None.

DATA AVAILABILITY STATEMENT

Data and original images in the current study are available from the corresponding author upon reasonable request. The authors can confirm that all relevant data are included in the article.

CONSENT STATEMENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy. There are no conflicts of interest to declare.

ORCID

Masanori Hashimoto https://orcid.org/0000-0001-5381-0048
Tadatsugu Morimoto https://orcid.org/0000-0002-3359-9684

REFERENCES

1. Ishii K, Watanabe G, Tomita T, et al. Minimally invasive spinal treatment (MIST)-a new concept in the treatment of spinal diseases: a narrative review. *Medicina (Kaunas)*. 2022;58(8):1123. doi:10.3390/medicina58081123
2. Xu Z, Zheng Y. Anterior dislocation of fusion cage after minimal invasive transforaminal lumbar interbody fusion (MI-TLIF): a case report. *Biomed Res*. 2017;28:7834-7836.
3. Maeno T, Okuda S, Haku T, et al. Anterior migration of an interbody graft in posterior lumbar interbody fusion: report of three cases without removal of the migrated graft. *J Orthop Sci*. 2019;24(4):742-745. doi:10.1016/j.jos.2017.01.014
4. Garg B, Singla A, Batra S, Kumar S. Early migration of bone graft causing sigmoid colon perforation after trans-foraminal lumbar interbody fusion. *J Clin Orthop Trauma*. 2017;8(2):165-167. doi:10.1016/j.jcot.2016.12.008
5. Çakmak A, Gyedu A, Kepenekçi I, Ozcan C, Unal AE. Colon perforation caused by migration of a bone graft following a posterior lumbosacral interbody fusion operation: case report. *Spine (Phila Pa 1976)*. 2010;35(3):E84-E85. doi:10.1097/BRS.0b013e3181bb1bf2
6. Ceylan D, Yaldiz C, Asil K, Kaçira T, Tatarli N, Can A. Intraoperative antepulsion of a posterior lumbar interbody

fusion cage: three case reports. *Pan Afr Med J*. 2015;10(20):342. doi:10.11604/pamj.2015.20.342.5750

7. Proubasta IR, Vallvé EQ, Aguilar LF, Villanueva CL, Iglesias JJ. Intraoperative antepulsion of a fusion cage in posterior lumbar interbody fusion: a case report and review of the literature. *Spine*. 2002;27(17):E399-E402. doi:10.1097/00007632-200209010-00029
8. Murase S, Oshima Y, Takeshita Y, et al. Anterior cage dislodgement in posterior lumbar interbody fusion: a review of 12 patients. *J Neurosurg Spine*. 2017;27(1):48-55. doi:10.3171/2016.12.SPINE16429
9. Pawar UM, Kundnani V, Nene A. Major vessel injury with cage migration: surgical complication in a case of spondylodiscitis. *Spine*. 2010;35(14):E663-E666. doi:10.1097/BRS.0b013e3181d5fee3
10. Oh HS, Lee SH, Hong SW. Anterior dislodgement of a fusion cage after transforaminal lumbar interbody fusion for the treatment of isthmic spondylolisthesis. *J Korean Neurosurg Soc*. 2013;54(2):128-131. doi:10.3340/jkns.2013.54.2.128
11. Ariyoshi D, Sano S, Kawamura N. Inferior vena cava injury caused by an anteriorly migrated cage resulting in ligation: case report. *J Neurosurg Spine*. 2016;24(3):409-412. doi:10.3171/2015.6.SPINE1544
12. Kumar M, Kaucha D, Adsul N, Chahal RS, Kalra KL, Acharya S. Delayed asymptomatic retroperitoneal dislodgement into the pouch of Douglas of a TLIF cage: a case report and review of the literature. *Surg Neurol Int*. 2021;19(12):360. doi:10.25259/SNI_418_2021
13. Yoshimoto H, Sato S, Nakagawa I, et al. Deep vein thrombosis due to migrated graft bone after posterior lumbosacral interbody fusion. Case Report. *J Neurosurg Spine*. 2007;6(1):47-51. doi:10.3171/spi.2007.6.1.47
14. Reece EM, Davis MJ, Wagner RD, et al. Vascularized bone grafts for spinal fusion-part 1: the iliac crest. *Oper Neurosurg (Hagerstown)*. 2021;20:493-496. doi:10.1093/ons/opab037
15. Dregelid E, Jenssen G, Jonung T, Braaten A. Pseudoaneurysm of the abdominal aorta due to a needle-like osteophyte on the first lumbar vertebra. *J Vasc Surg*. 2007;45(5):1059-1061. doi:10.1016/j.jvs.2006.12.070
16. Ruf M, Voigt A, Kupczyk-Joeris D, Merk HR. Perforation of the sigmoid colon due to intradiscal spacer dislocation. *Eur Spine J*. 2011;20:S289-S293. doi:10.1007/s00586-011-1696-7
17. Fang J-FMD, Chen RJ, Lin BC, et al. Small bowel perforation: is urgent surgery necessary? *J Trauma*. 1999;47(3):515-520. doi:10.1097/00005373-199909000-00014
18. Papadoulas S, Konstantinou D, Kourea HP, Kritikos N, Haftouras N, Tsolakis JA. Vascular injury complicating lumbar disc surgery. A systematic review. *Eur J Vasc Endovasc Surg*. 2002;24(3):189-195. doi:10.1053/ejvs.2002.1682
19. Bingol H, Cingoz F, Yilmaz AT, Yasar M, Tatar H. Vascular complications related to lumbar disc surgery. *J Neurosurg*. 2004;100(3 Suppl Spine):249-253. doi:10.3171/spi.2004.100.3.0249

How to cite this article: Hashimoto M, Hirata H, Tsukamoto M, Tomohito Y, Mawatari M, Morimoto T. Anterior graft migration in posterior lumbar interbody fusion: A case report and literature review. *Clin Case Rep*. 2023;11:e7847. doi:10.1002/ccr3.7847