Vertebral body augmentation (VBA) with cement has become a common procedure for the treatment of osteoporotic compression fractures. The procedure was originally described by Galibert et al. in France, but it is now most commonly used in treating compression fractures. The use of VBA, including both vertebroplasty and kyphoplasty procedures, increased 12,900% from 1993 to 2004. In 2009, after publication of several randomized controlled trials with negative results related to augmentation, the absolute rate of these procedures dropped by 5%. Despite this recent downturn, thousands of VBAs are still performed every year.

Given the large number of VBA procedures as well as the increasing life span of patients in economically developed countries, the likelihood that any given patient who has undergone a VBA may require subsequent spinal surgery is also increasing. Some of these patients will require instrumentation for fusion as a secondary procedure. One example of a common spinal disorder commonly treated with instrumentation is degenerative spondylolisthesis. This disease affects up to 8% of American women.

When the problematic spinal levels overlap, treatment challenges may arise. Although several studies have investigated the use of cement to augment pedicle screws in order to increase pullout strength, there have been no reports investigating methods of placing hardware into a previously cemented vertebral body. VBA to increase screw purchase is straightforward because the cement is placed in liquid form before or immediately after screw placement. However, a previously cemented level contains hard methylmethacrylate, which can render screw placement difficult.

In this report we present a case and describe, for the first time in the English-language literature, the treatment of a spondylolisthesis after a prior VBA at the same level. This technical report describes the method for managing augmented vertebral bodies, a problem that is likely to become a more common challenge in the future.

Case Presentation
A 68-year-old woman presented with a history of metastatic insulinoma and a known spondylolisthesis at L4–5 (Fig. 1). She was also severely osteoporotic (DEXA [dual-energy x-ray absorptiometry] scan T scores of −2.5 to −3.5 in the left femur) and had had fractures of the pelvis and left femur. She had chronic back and right lower-extremity pain, and the back pain had worsened after a minor fall. After being seen at an outside facility, she was treated with VBA using a vertebroplasty technique and methylmethacrylate at the L-1 and L-5 levels for compression fractures. Her back pain improved after the treatment, but her leg pain did not.
The pain progressively worsened over the next year until she presented to our institution with intractable back and right lower-extremity pain (Figs. 2 and 3). She had no left leg symptoms and no weakness, but was unable to ambulate because of the severe radiculopathy. We recommended a right-sided minimally invasive surgical (MIS) transforaminal lumbar interbody fusion (TLIF) at L4–5 with pedicle screws to address both the disc space collapse and the spondylolisthesis.

Given her multiple comorbidities a minimally invasive single-level operation was chosen. Moreover, her highly erratic blood glucose levels led us to choose the MIS TLIF approach to limit the risk of postoperative infection.

After an extensive preoperative discussion and evaluation and given the severity of her symptoms, the patient chose surgery. The procedure was performed with the patient in the prone position on a Jackson table. A midline incision was used, followed by placement of a Taylor retractor to allow access for a right-sided laminotomy and medial facetectomy. The nerve roots at L-4 and L-5 were decompressed dorsally, and the disc space was cleared of cartilage. An expandable allograft interbody cage (OptiMesh, Spineology), as well as 1.05 mg of recombinant human bone morphogenetic protein–2 (rh-BMP-2; InFuse, Medtronic Sofamor Danek) was placed into the L4–5 intervertebral space.

We then placed percutaneous pedicle screws (Viper, DePuy Synthes Spine) at L-4 and L-5. The most problematic site was on the left side of L-5, where most of the cement was concentrated. We initially placed a Jamshidi needle, followed by a K-wire, at the projection of the pedicle.
Because the actual trajectory could not be directly visualized, the bur hole was placed, under fluoroscopic guidance, along what we assumed to be the ideal trajectory (Fig. 4). A cannulated reamer was then placed into the drilled space and directed under anteroposterior fluoroscopic guidance along this idealized pedicle screw trajectory, through the cement mass (Figs. 5 and 6). This reamer had an outside diameter of 4 mm. After the hole had been drilled through the cement, a succession of 5-, 6-, and 7-mm taps were then used to machine the internal cement mass to accept a 7-mm cannulated pedicle screw. All of these steps were undertaken without direct visualization and under fluoroscopic guidance. The other 3 screws were placed and connected with subfascial rods without difficulty (Fig. 7).

Postoperatively, the patient awoke with no neurological deficits. Although she had incisional pain, her right leg pain had improved. When seen at the 2-week follow-up visit, she had some back and sacroiliac joint pain, possibly related to excessive bending, but the pain in her leg was lessened. At 2 months, she was ambulating with a walker, noting only minimal leg pain and numbness.

At 4 months postoperatively, she fell from a standing position and suffered a right femoral fracture that required internal fixation. At 9 months, a CT scan demonstrated fusion through the interbody graft (Fig. 8), no lucencies around the screws, and no fracture through the methylmethacrylate (Fig. 9). She had limited mobility, but this is due to pain in her right hip, which will require a total hip replacement. She had minimal back pain.
The number of Americans who have received a VBA is unknown; a conservative estimate is over 760,000. The application of both vertebroplasty and kyphoplasty procedures has been widespread given the high incidence of osteoporotic compression fractures in the elderly. It is now estimated that over 700,000 new vertebral compression fractures occur every year, about 270,000 of which are clinically detected, and that 14%–44% of these patients will receive a VBA. Given the minimally invasive nature of VBA, it is often perceived as a procedure that involves little risk to the patient. However, once the methylmethacrylate has been injected, it will remain in the patient’s body for the duration of his or her life unless it is surgically removed.

Spine surgeons will encounter patients who have undergone VBA, and will therefore need strategies for managing augmented vertebral bodies. Many surgeons feel that the presence of VBA contraindicates placement of transpedicular instrumentation. However, in this report we describe a method for performing the standard TLIF procedure after VBA. This technique is borrowed from methods used by orthopedic surgeons to achieve fixation in previously cemented bone, such as when managing an osteoporotic pelvis by reaming the cement using a cannulated stainless steel reamer with cutting blades. It should be noted that during reaming and tapping of the cement...
mass, it was important to employ a succession of graduated steps. This reduced the likelihood of weakening the mechanical interface between the cement mass and the surrounding osteoporotic bone.

Furthermore, this procedure is not a guarantee of fusion, but instead only serves to immobilize the spine to allow proper healing in the most desirable alignment. Long-term success in any fusion procedure is contingent upon achieving a successful bony arthrodesis. In this particular case it was believed that, by performing a 360° fusion with both an interbody cage and posterolateral bone graft, the opportunities for fusion could be maximized. In addition, rh-BMP-2 was used in the interbody space in an off-label application of the osteobiologic agent.

There are other strategies that could have been used to manage this patient. Bypassing instrumentation at L-4 and extending the fusion to the L-3 level was an option, but would have required fusion of a second asymptomatic spinal level. Alternate routes for fixation would have included cortical screws, transfacet screws, or interspinous clamps, which do not require entry into the vertebral body centrum. Another option would have been to perform a laminectomy with in situ fusion, avoiding the need for instrumentation altogether. This would not have allowed control of the spondylolisthesis or correction of the slip. Unilateral pedicle screws could also have been used, but given the patient’s severe osteoporosis it was decided that bilateral fixation was optimal better choice. Finally, a stand-alone interbody graft, such as an anterior lumbar interbody fusion (ALIF) or an extreme-lateral interbody fusion (XLIF), could also have been options.

Conclusions

As cement augmentation has become more common, it is likely that spine surgeons will encounter patients needing an instrumented fusion surgery with pedicle screws. If traditional methods fail to penetrate the cement, we recommend attempting to cannulate the cement using a reamer bit prior to placing the fixating screws.

References


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Conception and design: both authors. Drafting the article: Gernsback. Critically revising the article: both authors. Reviewed submitted version of manuscript: both authors. Approved the final version of the manuscript on behalf of both authors: Gernsback.

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