Vertebroplasty and kyphoplasty

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In this issue of *Neurosurgical Focus*, the contributors survey the background, present application, and future horizons of vertebroplasty and kyphoplasty. In the management of spinal compression fractures secondary to osteoporosis, trauma, hemangioma, myeloma, and osteolytic metastasis, these procedures yield analgesic effects and augment mechanical stability by fortifying weakened segments of the vertebral column.¹

Although percutaneous vertebroplasty with radiographic guidance was first performed in 1984, its use has grown exponentially in the past several years. The potential reasons for this phenomenon include the following: 1) aggressive marketing campaigns; 2) recent technical innovations and instrumentation enhancements; 3) the enfranchisement of neurosurgeons, orthopedic surgeons, and other nonradiologist practitioners; 4) the growing number of neurosurgeons with hybrid training in interventional neuroradiology techniques; 5) an ever-aging population, with commensurate increases in the incidence of osteoporotic spinal compression fractures (currently estimated at 700,000/year but expected to increase fourfold over the next 50 years)¹; and 6) the pervasive trend toward therapeutic minimalism.

The inaugural article, by Burton and colleagues, provides an overview of percutaneous spinal osteoplasty. The indications, technique, and outcomes of vertebroplasty and kyphoplasty are summarized, but it is imperative to realize that neither procedure has ever been subjected to prospective randomized trials comparing the outcome of these treatments with the natural history of the disease. Furthermore, kyphoplasty and vertebroplasty have never been directly compared in any study. Thus, the purported benefits of one procedure over the other remain speculative.

The next article, by Wong and Mathis, who together have amassed a robust experience with both procedures, offers several insights and practical pearls for averting complications. Villavicencio and colleagues present a further technical refinement, the adjunctive use of intra-

operative three-dimensional fluoroscopy-based navigation to guide placement of the access cannulas through the pedicles.

When kyphoplasty was introduced, one of the earliest claims advanced by its proponents was the potential to restore lost vertebral body (VB) height and reduce the associated kyphosis. The article by Ledlie and Renfro lends credence to this contention. They performed quantitative morphometric analysis pre- and postkyphoplasty and demonstrate a significant reduction in VB deformity as a result of treatment. In contrast, in the series by Feltes, et al., the authors failed to demonstrate any restoration of VB height. Nevertheless, all patients in that study experienced profound clinical improvement. Thus, the impact of kyphoplasty on spinal alignment and the relationship of this effect on pain relief remain unresolved controversies.

The next series of articles address the application of kyphoplasty to specific patient populations. Deen and colleagues report their experience with the treatment of sacral insufficiency fractures and vertebral compression fractures in organ transplant recipients. Gerszten, et al., present combination kyphoplasty and CyberKnife radiosurgery as a new paradigm in the treatment of pathological compression fractures, which require a stabilization procedure for mechanical back pain as well as management of the underlying malignant process. Acosta and colleagues describe their initial clinical experience with kyphoplasty to augment short-segment pedicle screw fixation of traumatic lumbar burst fractures. In theory, conventional vertebroplasty may be just as beneficial in all these applications as kyphoplasty.

Finally, Lam and Khoo report a novel device for percutaneous spinal osteoplasty that circumvents some of the limitations of current technology. Polymethyl methacrylate cement has a number of undesirable attributes, including the potential for thermal necrosis and its inability to integrate with the skeleton. Future treatment of compression fractures will likely consist of injecting materials such as hydroxyapatite, hormones, osteogenic growth fac-

tors, allograft or autograft, and other agents that induce bone regeneration. Biodegradable bone mineral substitutes that resorb as the bone remodeling proceeds are currently in evaluation, as are osteoconductive materials such as coral exoskeleton.¹ Newer systems for vertebral augmentation will combine minimally invasive surgical access with bioactive, injectable material to restore VB height and sagittal alignment, provide structural stability by sustaining physiological loads, and allow for the incorporation of graft material into native vertebral bone. Although the device reported by Lam and Khoo is in its infancy in terms of clinical implementation, it heralds a potential new approach to percutaneous spinal osteoplasty.

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Reference

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