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Clinical Study

Short-segment percutaneous pedicle screw fixation with cement augmentation for tumor-induced spinal instability

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Abstract

BACKGROUND CONTEXT: Pathologic vertebral compression fractures (VCFs) represent a major source of morbidity and diminished quality of life in the spinal oncology population. Procedures with low morbidity that effectively treat patients with pathologic fractures are especially important in the cancer population where life expectancy is limited. Vertebroplasty and kyphoplasty are often not effective for mechanically unstable pathologic fractures extending into the pedicle and facet joints. Combination of cement augmentation and percutaneous instrumented stabilization represents a minimally invasive treatment option that does not delay radiation and systemic therapy.

PURPOSE: The objective of the study was to evaluate the safety and efficacy of cement-augmented short-segment percutaneous posterolateral instrumentation for tumor-associated VCF with pedicle and joint involvement.

METHODS: Forty-four consecutive patients underwent cement-augmented percutaneous spinal fixation for unstable tumors between 2011 and 2014. Retrospective analysis of prospectively collected data, including visual analog pain scale (VAS) response score and procedural complications, was performed.

RESULTS: Patients with a median composite Spinal Instability Neoplastic Scale score of 10 (range=8–15) were treated with constructs spanning one to four disk spaces (median of two spaces, constituting 84% of all cases). The proportion of patients with severe pain decreased from 86% preoperatively to 0%; 65% of patients reported no referable instability pain postoperatively. There was one adjacent-level fracture responsive to kyphoplasty, and one case of asymptomatic screw pullout. Two patients subsequently required decompression in the setting of disease progression despite radiation; there was no perioperative morbidity.

CONCLUSIONS: Percutaneous cement-augmented posterolateral spinal fixation is a safe and effective option for palliation of appropriately selected mechanically unstable VCF that extends into pedicle and/or joint.

Keywords: Kyphoplasty; Percutaneous spinal fixation; Posterolateral instrumentation; Spinal metastases; Vertebral compression fracture; Vertebroplasty

Introduction

Spinal metastases represent a significant source of morbidity in cancer patients resulting in spinal cord or cauda equina compression and spinal instability. The Spine Oncology Study Group (SOSG) defines spinal instability as a "loss of spinal integrity as a result of a neoplastic process that is associated

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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EVIDENCE & METHODS

Context
As surgical intervention for spinal tumors becomes more common, it is clear that a better evidence base in support of various approaches to surgical care must be developed. The authors advocate that short-segment percutaneous pedicle screw fixation with cement augmentation can be effective in the setting of pathologic fractures and does not delay radiation or chemotherapy. They present their experience with this technique in a series of 44 patients.

Contribution
In this heterogeneous case series, the patients report overwhelmingly successful surgical interventions with relatively little if any peri-operative morbidity. These findings lead the authors to conclude that short-segment percutaneous pedicle screw fixation with cement augmentation is a safe and effective approach to the treatment of tumor-induced spinal instability.

Implications
The reader should appreciate that the results of this study are highly influenced by selection as well as indication and possibly information bias. The results achieved at this specialized tertiary center may also not be applicable to other patients with tumor induced spinal instability in dissimilar clinical contexts. However the data may have been obtained, the small sample size, potential for indication and selection bias, as well as the clinical heterogeneity extant in the population under study mean that this work can provide no better than Level III-IV evidence.

—The Editors

with movement-related pain, symptomatic or progressive deformity, and/or neural compromise under physiologic loads.'' [1] Furthermore, the SOSG clearly delineated considerations necessary to evaluate spinal stability in cancer patients through the development and validation of the Spinal Instability Neoplastic Scale (SINS) [2].

The combination of poor bone quality, radiation, and chemotherapy severely undermines the potential for osseous healing in cancer patients [3]. Cancer-associated spinal instability thus often requires stabilization because these patients have very low likelihood of bone healing with immobilization. Surgical intervention in the metastatic cancer population is palliative, and these patients should, therefore, be considered for less invasive procedures that limit the interruption of systemic therapy and allow for the delivery of early adjuvant radiation. Minimally invasive surgical (MIS) techniques have gained popularity in treating spine trauma, deformity, and degenerative disease. In cancer patients, spinal MIS techniques have the potential to decrease surgical morbidity and facilitate the return to early systemic and radiation therapy. As in all areas of spine surgery, MIS techniques must be implemented with the clear understanding of the surgical goals and without compromising the ability to safely accomplish them. Minimally invasive surgical techniques use smaller incisions and inflict less tissue damage, which in turn should facilitate postoperative healing and decrease the risk of wound complications, particularly in the setting of postoperative radiation or systemic therapy.

Minimally invasive cement augmentation techniques such as kyphoplasty and vertebroplasty have been shown to provide effective pain relief in patients with cancer-related vertebral compression fractures (VCFs) [4–9]. However, in our experience, patients with vertebral body fractures that extend into the pedicles and/or joints do not respond favorably to percutaneous cement augmentation alone and often require a posterior element support. These patients represent an ideal population for combination of percutaneously placed pedicle screws and cement augmentation. We analyzed the outcomes of spine stabilization in unstable, symptomatic neoplastic vertebral body fractures extending into the posterior elements using percutaneous pedicle screws and vertebral cement augmentation.

Methods

Patient selection and characteristics

Patients were evaluated by a multidisciplinary spinal oncology program, comprising neurosurgeons, radiation oncologists, orthopedic surgeons, neurointerventional radiologists, and physiatrists. Forty-six consecutive patients, aged 29 to 83 (median=60 years), presenting with tumor-related pathologic compression or burst fractures that extended into the pedicle and/or joint, resulting in mechanical instability, and who underwent percutaneous pedicle screw instrumentation were included in this study (Table 1). Two patients were excluded because they were lost to follow-up immediately after surgery, resulting in 44 patients whose outcomes were analyzed. The first excluded patient was discharged to a hospice because of postoperative finding of significant cancer progression, and the second patient was discharged to an acute rehabilitation facility in a different state and did not return for follow-up. All fractures were in thoracic or lumbar spine, with the majority at the thoracolumbar junction (Table 2). Symptomatic mechanical instability was present in all patients, manifested as movement-related pain. In the lumbar spine, the pain was typically exacerbated with standing or sitting. In the thoracic spine and thoracolumbar junction, instability pain is often manifested in recumbency as the patient straightens and thus hinges on an unstable kyphosis. Most commonly, these patients report sleeping upright in a