

Use of C2 vertebroplasty and stereotactic radiosurgery for treatment of lytic metastasis of the odontoid process

ABSTRACT

Improvements in cancer therapy have led to increased patient survival times in spite of metastatic spinal disease in many forms of cancer. Conventional treatment methods often employ radiotherapy with or without surgery depending on the neurological status, mechanical instability, and the extent of tumor. Percutaneous vertebroplasty as well as stereotactic radiosurgery (SRS) have arisen as common modalities of treatment of spinal metastasis in which neurological compromise or spinal instability and deformity is not of significant concern. These treatments, when used in combination, have been shown to provide early pain relief and effective tumor control while avoiding surgical resection, fixation, and lengthy recovery times. We present a case unique in the literature for the use of this combination treatment for tumors of the C2 vertebral body. While limited in application to patients without overt atlantoaxial instability or significant spinal canal compromise, we believe it provides a significant benefit in decreasing morbidity and improving early adherence to systemic therapy.

Keywords: Cement augmentation, odontoid tumor pathology, stereotactic radiosurgery

INTRODUCTION

Spinal cancer metastasis is the most common in the thoracic spine (60%), followed by the lumbosacral spine (30%) and the cervical spine (10%), with approximately 20,000 new cases reported annually.^[1-5] Conventional treatment methods are palliative and include surgery and radiotherapy, to both stabilize the spine for mechanical control of back pain and halt the malignant process.^[1,6]

Recently, vertebroplasty has risen as a nonsurgical stabilization technique for palliative pain treatment in patients with mechanical instability due to spinal metastasis. Vertebroplasty or cement augmentation involves a percutaneous injection of polymethylmethacrylate cement to stabilize the remaining vertebral structures as well as relieve pain immediately.^[1,3,5,6]

Radiotherapy has been reported as providing less than optimal pain relief and tumor control, as dosage is limited by the low tolerance of the adjacent spinal cord.^[1,2,5,6] Stereotactic radiosurgery (SRS) has been developed as an alternative to conventional radiotherapy methods in which

imaging advancements and intensity-modulated radiation have allowed for directed high-dosage, intensity-modulated beams of radiation.^[5,6]

Cervical spinal metastasis is the rarest of spinal metastasis, and incidence at the C2 vertebra comprises <1% of these malignancies.^[7] We present the case of a lytic metastasis of C2 treated with both a fluoroscopy-guided vertebroplasty using an anterior cervical approach, followed by SRS of the affected area. This course of action was used to successfully stabilize the C2 vertebra to improve pain, as well as treat the underlying malignant process, leading to significant pain relief and an improved quality of life for the patient. A few instances of vertebroplasty followed by SRS for the treatment of spinal malignancies have been presented in the

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How to cite this article: Hribar CA, Bhowmick DA. Use of C2 vertebroplasty and stereotactic radiosurgery for treatment of lytic metastasis of the odontoid process. *J Craniovert Jun Spine* 2017;8:285-7.

Access this article online	
Website: www.jcvjs.com	Quick Response Code 
DOI: 10.4103/jcvjs.JCVJS_63_17	

literature, with no literature, to the best of our knowledge, existing of these techniques being used in sequence at the craniocervical junction. Our results indicate the safety and efficacy in treating lytic lesions in this manner at the C2 level.

CASE REPORT

Presentation

A 44-year-old female with a <1 year history of locally advanced breast cancer presented for outpatient evaluation of new-onset neck pain. She noted the pain to be worse with rotation of the head and extreme flexion. She did not note any new weakness, numbness, or gait disturbance. On examination, she was guarded in her ability to move her head, as it elicited significant neck pain. She had normal reflexes and full strength on motor examination. Magnetic resonance imaging of the cervical spine revealed a new C2 vertebral metastasis centered about the base of the odontoid process without central canal stenosis [Figure 1]. There was evidence of partial posterior cortical surface violation and pathological fracture of the odontoid process without evidence of anterior cortex breakage on computed tomography imaging.

Clinical decision-making

As this was the patient's first presentation of likely metastatic disease, biopsy and advancement of the patient's medical therapy was of high importance to her oncology treatment team. However, due to the location of the patient's lesion, her mechanical symptoms, and likely impending pathological complete odontoid fracture, a standard surgical treatment would involve C1–2 fusion with or without transoral resection. This would be fairly morbid in the short term and delay the onset of the needed oncological treatment. The alternative standard transoral needle biopsy and radiotherapy would not address the patient's bony pathology

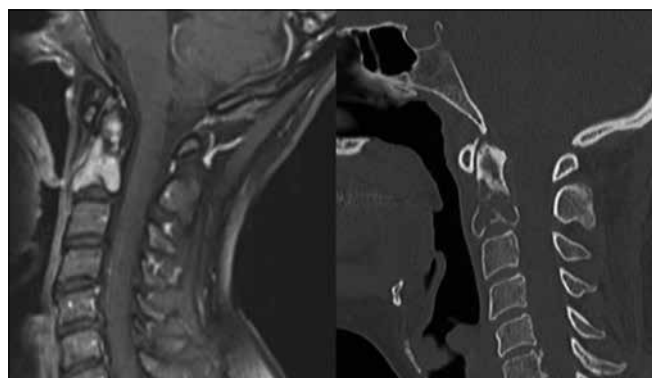


Figure 1: A 44-year-old female with a previous history of breast cancer presenting with new-onset of neck pain associated with head rotation and extreme flexion. Magnetic resonance imaging (left) demonstrates the involvement of tumor within the C2 vertebra and odontoid process with significant bony loss and unicortical defect on computed tomography imaging (right)

or mechanical symptoms, and could result in possible infectious complications. Thus, a hybrid approach was suggested, using an anterior cervical transodontoid biopsy and cement augmentation followed by SRS. Postoperative chemotherapy could be initiated early, and the patient could have a significantly shortened recovery time with some level of increased bony stability.

Operative intervention and follow-up

A standard right-sided anterior cervical incision was made, and an approach similar to an odontoid screw was undertaken using a Jamshidi needle. After cannulating the C2 vertebral body, a biopsy was taken of the tumor in the odontoid process using a standard bone coring needle. Cement was then instilled within the C2 vertebra with continuous biplanar fluoroscopy until the lytic defects were adequately filled [Figure 2].

The patient was discharged from the hospital on the first postoperative day without any new neurological deficits. Her preoperative neck pain had completely resolved with a full range of motion in her neck. The patient underwent SRS on the postoperative day 5 using the Cyberknife radiation delivery system at a dose of 18 Gy to the 87% isodose line conforming to the C2 vertebral body. Six-week and 6-month follow-ups were unremarkable, with no evidence of tumor recurrence or new evidence of atlantoaxial instability [Figure 3].

DISCUSSION

Vertebroplasty allows for stabilization without surgical fixation for patients presenting with moderate instability. Recovery time is greatly decreased, with most leaving the same day, as well as pain relief being near instantaneous. The safety and efficacy of vertebroplasty for treatment of osteolytic metastasis and osteoporotic compression fractures is well documented, with pain reduction achieved in more than 90% of patients for most studies.^[3,5,6] Vertebroplasty



Figure 2: Operative procedure involved an anterior cervical approach with cannulation and biopsy of the C2 vertebra followed by instillation of cement as seen on intraoperative fluoroscopy



Figure 3: Six-month postoperative computed tomography imaging shows no evidence of lytic tumor recurrence, evidence of cement migration, or new C2 fracture

can be utilized in patients with more severe instability when alternative decompression or tumor volume reduction treatments are employed as well.^[2,3]

The C2 vertebra presents additional challenges as opposed to the remainder of the spine due to its complex regional anatomy. Unfortunately, transoral approaches to the odontoid can carry significant risks of postoperative dysphagia, prolonged intubation, and infection, especially in the setting of malignancy and radiation. Posterior approaches are also challenging in this region as small pedicles can increase the risk of vascular and neurological injury, as well as require a significantly extended length of surgery without significant benefit in resection volume.^[7]

Conventional radiotherapy can typically be administered only once, and at low, often nontumorcidal dosages, due to the low radiation tolerance of the spinal cord.^[2,6] With SRS, high dosages of radiation can be administered during a one-time treatment to targeted areas with little effect on the surrounding structures. In avoiding the spinal cord, bone marrow reserves can also be preserved as well.^[2,5,6] Larger and more directed dosages can provide longer-lasting pain relief, as well as provide over 90% tumor control.^[2,5]

In this case, both vertebroplasty and SRS were utilized to treat a lytic lesion of the C2 vertebra, due to the pain relief and quality of life benefits they both achieve when used in tandem. The combination treatment allows for immediate

pain relief, and a single-fraction radiation dose, without accompanying bony loss, or need for surgical resection or fixation. Many studies have shown the safety and efficacy of these procedures separately, as well as have contributed to the growing body of literature on their effective combination in patients with spine metastasis who do not have significant spinal cord compromise.^[1,6]

To the best of our knowledge, this is the first report of using this combined technique for treatment of lytic lesions of the C2 vertebra or the craniocervical junction. The craniocervical junction presents many risks when it comes to surgical intervention. Having a pain relief and malignancy-controlling treatment combination that is also outpatient and very low risk can provide quicker, more effective symptom relief and increase the quality of life for these patients.

Financial support and sponsorship

Nil.

Conflicts of interest

Corresponding author is an educational consultant for Medtronic Inc.

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