Original Article

Pain Control by Image-Guided Radiosurgery for Solitary Spinal Metastasis

Samuel Ryu, MD, Ryan Jin, MD, Jian-Yue Jin, PhD, Qing Chen, PhD, Jack Rock, MD, Joseph Anderson, MD, and Benjamin Movsas, MD
Departments of Radiation Oncology (S.R., R.J., J.-Y.J., Q.C., B.M.), Neurosurgery (S.R., J.R.), and Medical Oncology (J.A.), Henry Ford Hospital, Detroit, Michigan, USA

Abstract
Precision and accuracy of image-guided spinal radiosurgery has been previously demonstrated. This study was carried out to determine the clinical efficacy of spine radiosurgery for the treatment of solitary spinal metastases with or without cord compression. A total of 49 patients with 61 separate spinal metastases were treated with radiosurgery. All patients had pathologically proven primary cancers and had either synchronous or metachronous metastasis to the spine. The majority of the patients presented with back pain. All patients received single-dose radiosurgery to the involved spine only. The radiosurgery dose ranged from 10 to 16 Gy. The primary endpoint was pain control, but outcomes in neurological status and radiological tumor control also were assessed. The median time to pain relief was 14 days and the earliest time of pain relief was within 24 hours. Complete pain relief was achieved in 46%, partial relief in 18.9%, and stable symptoms in 16.2%. Relapse of pain at the treated spinal segment was 6.9%. Median duration of pain relief at the treated spine was 13.3 months. Overall pain control rate for one year was 84%. This experience demonstrates that spinal radiosurgery can achieve rapid and durable pain relief. Single-dose radiosurgery has a potential to be a viable treatment option for single spinal metastasis. J Pain Symptom Manage 2008;35:292–298.

Key Words
Pain control, spine radiosurgery, stereotactic radiosurgery, spine metastasis

Introduction

Among the tumors arising from the spine, metastatic involvement is the most common. Patients with spine metastasis almost invariably present with back pain. Sometimes, neurological manifestations occur by epidural spinal cord or cauda equine compression, which may cause isolated radiculopathy, or more diffuse weakness of extremities, sensory deficits, or bowel and bladder changes.[1] Effective treatment at the time when the patient is still ambulatory leads to the best chance for maintenance of excellent quality of life.[2]

Treatment of spine metastases or spinal cord compression is palliative. Standard treatment includes pain medications and steroids,

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Address correspondence to: Samuel Ryu, MD, Department of Radiation Oncology, Henry Ford Health System, 2799 West Grand Boulevard, Detroit, MI 48202, USA. E-mail: sryu1@hfhs.org

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external beam radiation therapy, surgical decompression, and in certain circumstances, chemotherapy.[3,4] External beam radiation therapy is offered in the vast majority of patients and achieves varying degrees of pain relief.[3] Conventional radiotherapy is given to the area of 1−2 vertebral segments above and below the involved spine and uses multiple sessions of fractionated treatment over several weeks. Surgery is offered to establish a diagnosis, repair spinal instability, address a posterior lesion, or rapidly decompress when the lesion is relatively radioresistant and neurologic signs are emerging.

These treatments have been used for palliative purposes because the prognosis of patients with spinal metastasis has been generally poor, with a limited survival time.[3−5] As cancer patients experience longer survival, quality of life has become an important factor not only in making decisions to provide more definitive treatment but also to offer a palliative treatment with more durable pain control. This is particularly true in the treatment of spine metastasis, because pain and neurologic symptoms further reduce quality of life. Therefore, the goals of the treatment for spinal metastasis should be to relieve pain, preserve or restore neurologic function, and control the tumor, while remaining a convenient and nonburdensome form of therapy for the patient.[6]

Radiosurgery delivers a large, highly conformal radiation dose to a localized tumor by a stereotactic approach. This requires accurate targeting and immobilization of the target organ during irradiation. The difficulty in applying radiosurgery to the extracranial site is mainly due to organ motion associated with breathing and lack of immobilization techniques. Among the extracranial organs, the spinal cord and vertebra are the organs with the least breathing-related organ movement. This makes the spinal cord and vertebra suitable for stereotactic radiosurgery. We have demonstrated the precise targeting of spinal radiosurgery with the accuracy 1.36 ± 0.11 mm in actual patient treatment.[7] With this level of clinical accuracy, we extended the spinal radiosurgery to treat single spinal metastasis. We report here the clinical outcomes of spinal radiosurgery in patients who had a single isolated spinal metastasis. The results demonstrate the effectiveness of single-dose radiosurgery for pain relief, and neurological improvement with radiological tumor control of the epidural or paraspinal soft tissue component.

Methods and Materials

A total of 49 patients with 61 spinal metastatic lesions were treated with radiosurgery alone from May 2001 to May 2003. All patients had a histological diagnosis of malignant neoplasm and had either synchronous or metachronous metastasis to a single spinal segment, with or without cord compression. Five patients who had progressive metastasis at other untreated sites but single involvement at the time of each presentation were included. This study was approved by the Institutional Review Board regarding human subjects. Spinal metastasis was diagnosed by computed tomography (CT) and magnetic resonance imaging (MRI). All patients had no previous radiotherapy to the involved spinal lesion. Patient characteristics are summarized in Table 1.

All patients received single-dose radiosurgery to the involved spine only. The radiosurgery dose ranged from 10 to 16 Gy and was prescribed to the periphery of the target tumor volume encompassed by the 90% isodose line. The radiosurgery doses were 10 Gy in 6 lesions, 12 Gy in 20 lesions, 14 Gy in 20 lesions, and 16 Gy in 15 lesions. Seventeen lesions presented with neurologic signs of motor weakness or sensory change in the extremities. Twelve lesions were treated with decompression surgery followed by radiosurgery within 2−4 weeks of surgery. The other five patients were treated with radiosurgery alone. Sixteen patients were receiving chemotherapy for progressive primary or metastatic disease at the time of radiosurgery. No patient had concurrent chemotherapy with radiosurgery. Because radiosurgery was given in a single session, the chemotherapy schedules were unaltered.

Radiosurgery

The details of the procedure of radiosurgery have been previously described.[8,9] The procedure was performed on an outpatient basis. Patients were immobilized with a vacuum bag. CT-based treatment planning was